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AMERICAN JOURNAL OF OPHTHALMOLOGY

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FIFTY YEARS' EXPERIENCE IN OCULAR MOTILITY*

Part I

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It is an honor that I deeply appreciate to be invited to speak to you. I propose to cull from the harvests of 50 years some of the pickings that have survived repeated threshing and winnowing. Being thoroughly convinced myself of the validity of the ideas that I shall present, I naturally hope to persuade some of you to look more carefully at ideas you have ignored. Remember that one should not hesitate to change his views for good reasons. Not all change is progress, but without change progress is impossible.

It was my good fortune to begin the study of ophthalmology under Professor Mauthner of Vienna. As an undergraduate, I had not attended a single lecture or demonstration in the field of ophthalmology. None was required. Mauthner was particularly strong in physiological optics and in neuro-ophthalmology. In ocular motility he was at the top among German-speaking ophthalmologists; Landolt of Paris was his peer among the French-speaking, and Stevens of New York among English-speaking ophthalmologists.

Later, in Edinburgh, I met Dr. Ernest Maddox, who was first assistant to Mr. Berry. He had just invented the Maddox test and told me how he happened to find it. He was working with the double-prism test (two prisms base to base) and noticed that the two images of a light seen through such a prism were connected by a faint but easily perceived luminous streak. It was apparent that this streak was caused by the slight rounding of the edge where the two prisms met. Maddox found that a glass rod of small diameter produced a similar line, only more brilliant and easily seen. A cylindrical lens also produces a similar line, except that it is very short.

The supreme debt I owed to Mauthner was the founding of my knowledge of ocular motility on the sure basis of sound physiology. Too much emphasis cannot be placed on the physiology of the eye; it is the only foundation for sound practice. Only those methods that *are* founded on sound physiology will survive—will prove of permanent value.

I shall not attempt an historical survey, much less an autobiography. From this time on my personal progress depended on a study of the literature and on observation and experiment. Of the literature of that time the "American text book of ophthalmology," edited by Norris and Oliver; the translation by Culver of Landolt's "Refraction and accommodation"; Tscherning's "Physiological optics," published by The Keystone, organ of the Jewelry and Optical Trades; Maddox's little book; Helmholtz's classic, "A treatise

*Read before the Pacific Coast Oto-Ophthalmological Society in June, 1940.

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on physiological optics," and above all the current periodicals, in which articles by Stevens, Duane, and others appeared from time to time, were the sources from which I drew. Later on I shall have something to say about the literature of the present.

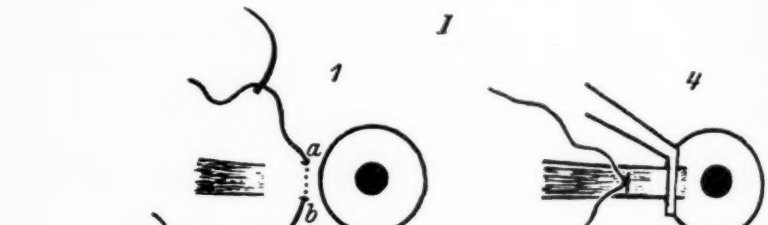

Fig. 1 (Lancaster). Advancement according to Verhoeff. It would be easy to collect 50 more by various contributors showing the same disregard for anatomical proportions.

Anatomical factors

Anatomy is a subject in which, it might be thought, finality would be reached at an early period. The origins and insertions of the muscles, their relations, their innervation, all these have long been known. For example, the distances of the insertions of the rectus muscles from the cornea are known to the tyro. But an erroneous idea that I have long enjoyed lambasting is that the tendons and muscles are only a few millimeters wide. Forty or fifty years ago, many, perhaps most, of the illustrations of muscle operations showed the rectus muscles only 5 mm. or even less in width (fig. 1.) Actually the narrowest tendon is that of the lateral rectus, 9.5 mm. wide. It is not generally realized that the distance from one rectus muscle to the next—for example, from the lateral rectus to the inferior rectus—is less than the width of the tendon, being 7 mm.; from the mesial to the inferior rectus is only 5.5 mm.

Little is said about the size and strength of the ocular muscles themselves. To combat the widespread notion that these muscles are often weak and that heterophoria is invariably due to weakness of one or more muscles, I made a study of their

anatomy and physiology for a paper before the Southern Medical Association.* The six extraocular muscles are all of about the same length, 40 mm.; their tendons differ in length, but the muscle belly will be found to be very close to 40 mm. long. In cross section the muscles vary a good deal, the medial rectus being the largest. Their areas range from 10 to 18 sq. mm. The individual fibers are smaller than those in any other voluntary muscles and are therefore more numerous per square millimeter of cross section. There are two sizes of nerve fibers and there is a dual innervation—probably motor and sensory. The ocular muscles have other peculiarities, different from other human voluntary muscles, whose significance is not known.

What *is* definitely known is that when a muscle is innervated to contract, the strength of pull is regulated by the number of fibers made to contract at one time. If a nerve transmits a stimulus at all, it is of maximum intensity. If a muscle fiber contracts at all, it contracts with its full force, its maximum power. This is the all-or-none principle. Thus the strength of pull of a muscle is regulated with great nicety by the number of its fibers that are made to act at one time. This is further favored in the case of the ocular muscles by the great number of nerve fibers and nerve endings in their motor nerves. In some of the large muscles of the body—for example, of the thigh—a single nerve fiber activates many muscle fibers.

The strength of the pull depends, then, on the number of fibers activated at one time. Many experiments have been made to determine the strength of pull per square millimeter of cross section. Following Weber and Haughton, I have accepted 62.5 grams per square millimeter as a fair estimate of the contractile power of striated muscle. Some authorities put it much higher. At this rate, each of the ocular muscles should have a maximum strength of 750 to 1,000 grams, provided all the fibers contracted at once.

The amplitude of excursion—the amount of shortening that can occur when a muscle contracts—is about one half to one third its length; that is, a muscle 40 mm. long could shorten 13 mm. or more. For the eye, this is over 65 degrees of arc. The eyes are capable of rotation of only 40 or 50 degrees from the primary position. More than that would not be useful because of the configuration of the orbit and face, a configuration made necessary for the proper protection of the eyes from injury. Moreover, and as a matter of fact, 99 percent of the ocular excursions are less than 15 degrees from the primary position—a curiously overlooked but enormously important fact. To protect the optic and ciliary nerves and blood vessels which are attached to the eyeball from undue stretching or jarring when the eyes are rotated, we have the check ligaments. Thirty or fifty years ago, it was quite generally believed that the amplitude of rotation was a measure of the strength of the ocular muscles. Some cling to the belief even today that one can measure the strength of an ocular muscle by observing how far it can move the eyeball in its direction; for example, that the strength of the lateral rectus is shown by the magnitude of its abduction. Hence the tropometer of Stevens, which was supposed to be a guide to the weak muscle and therefore the one needing treatment by operation or by exercise, to weaken or to strengthen it, as the case may be.

With the aid of Professor Kennelly I estimated the pull required to rotate the eyeball—1 to 1¾ grams, neglecting friction and estimating the weight of the eye as 8.0 grams, its size as 24 mm. in diame-

*Southern Medical Journal, 1923, page 38.

ter. Even when making liberal allowance for the extra weight and drag of the optic and ciliary nerves, the arteries and vortex veins, the conjunctiva, the fascia, and fat, we may safely say that a pull of five grams is sufficient to move the eye at its observed velocity. In other words, it may be said that the extraocular muscles are powerful enough to exert a pull 100 times the amount needed to move the eye. Hence, one is not surprised to find the superior rectus, one of the weaker muscles, able to spare half its fibers to move the lid up when the levator has failed (Motais operation), or to replace the lateral rectus in permanent paralysis of that muscle.

This throws a flood of light on the observed fact that people can move their eyes back and forth across the page for hours and hours without fatigue. As I picture it, less than 5 percent of the fibers (perhaps less than 1 percent, but allowance must be made for tonus) are made to contract at any one time. Thus, before the first set of fibers becomes fatigued, the task is shifted to a different set, and so on. By the time it is necessary for the first set to act again, they have long since recuperated completely. This agrees with the experiments of Mosso and other Italians on the finger muscles. They found with the recording ergograph that the finger could raise a light weight up and down indefinitely with no falling-off in amplitude. Only when the weight exceeded a critical magnitude did the curve show a falling-off, such as Howe thought he found with his ergograph when working with the ciliary muscles.

An important practical application of this great margin of strength is found in cases of paresis of an ocular muscle.

A lateral rectus may be partially paralyzed, and yet when the patient is required to follow a pencil moved slowly to the right and left, in many cases no limitation of movement can be detected in the direction of the paretic muscle. This is because it takes only a small fraction of the whole power of the muscle to move the eye to the limit, the edge of the cornea slightly beyond the outer canthus; hence, by exerting a greater effort, the weakened but not totally paralyzed muscle is able to move the eye as far as the check ligament permits.

How then can you determine that there is a paresis? By the action of the other, nonparalyzed eye. Since the innervation is never to one eye alone but always to both (binocular), and always equally to both, the effort required to move the paretic eye moves the other too far and too fast. It overshoots the paretic eye and reaches the limit set by its check ligaments ahead of the other eye. This is simply a manifestation of the secondary deviation of the sound eye when the weak eye is the fixating eye. Conversely, when the sound eye fixates and follows the pencil, that eye reaches its limit of rotation before the weakened eye. This can be illustrated with the red-green test. At first, the diplopia increases (images get farther apart) as the eyes move in the direction of the paretic muscles. When the sound eye reaches its limit, set by its check ligaments, the weaker eye still has some distance to go, and as it continues to move (by extreme effort) the separation of the double images diminishes (Bielschowsky).

Doubtless there are some who cling to the belief that weakness of a muscle or muscles is the thing to look for in dealing with a heterophoria. But is it not apparent that the muscles simply do what the nerves tell them to do? The nerves merely transmit the messages from the motor nuclei. The nuclei are coördinated and controlled by a supranuclear mechanism. It is this supranuclear mechanism which, receiving the messages from all sources,

including the voluntary centers of the brain, arranges the proper pattern of stimuli to the nuclei to execute a well-chosen response; in other words, a reflex, but a special type involving the will.

Is there then no such thing as a weak muscle? Of course there is. A muscle may have trichinosis. Toxic goiter may cause profound disturbance of the ocular muscles themselves. There may be a congenital aplasia of a muscle or an anomalously small, ill-developed muscle. All these, however, compared to the prevalence of heterophoria, are rarities. For heterophoria is universal. Orthophoria does not exist. Cases of orthophoria so-called are those showing so small a deviation (less than 0.50^{Δ}, perhaps less than 0.1^{Δ}) that the amount is negligible.

Another anatomical consideration to which I gave some study concerns the techniques of advancement operations. It has to do with the structure of the muscle and its tendon. Fifty years ago, advancement was an operation to be undertaken with fear and trembling. Landolt, for example, advised that surgeons do not look at the eye for four or five days after the operation, lest opening the eye might induce movement of the eye and so cause the suture to slip. The hold was secure on neither the muscle nor the eyeball. It was the custom to pass a stitch through the muscle and through the conjunctiva near the cornea, in the hope that it would not give way either at the conjunctiva or at the muscle. I was sure that a simple stitch through the muscle was quite inadequate to hold it, but to prove it, I took a fish-weighing or baby-weighing spring balance and put in a different spring, so that on the scale one space was equal to the pull of one gram. I had my intern, Dr. Peter Hunter Thompson, pass stitches through the muscles and the tendons in eyes he was enucleating, and measure the traction required to pull out the stitch under different conditions. Of course it showed that, in the case of the muscle, the pull needed was so small it could hardly be measured.

This was in 1901, just as I was forced to give up work for about 10 years on account of ill health, so that I did not publish the experiment. It led Dr. Thompson to adopt a stitch woven in and out across the muscle to secure a safe hold. I adopted at first the whip-stitch method, which I learned from Ziegler, and added what I called a security stitch. This was a mattress stitch through the tendon stump and the muscle and the conjunctiva, firmly uniting the muscle to the old attachment. Later, I omitted the advancement suture, which anchored the muscle to the sclera in front of its old insertion, as this was found to be superfluous in the presence of the mattress suture of muscle to tendon stump. This made the operation a simple resection, and such it has remained. A more simple, accurate, dependable, and easily performed method of shortening a rectus muscle has not been devised.

It was at about this time that I discovered that vitreous loss from "squeezing" was due more to the action of the six extraocular muscles than to that of the orbicularis. The importance and significance of this observation has been slow of reception by the profession. Duke-Elder, when I called his attention to it, responded with an emphatic endorsement. He had proved it by experiments with curare and other drugs. Notice, too, that it required no especial keenness of observation to detect the ocular retraction movement that often occurs when the patient sees the tonometer approach his eye. This flinching is precisely similar to the "squeezing" of cataract patients. I have seen a patient raise his intraocular pressure as much as 15 mm., so that the Schiötz reading was 35, but after another

drop of tetracain and a few words exhorting relaxation, the reading was just under 20 mm. Hg—a source of error worth bearing in mind.

The obvious lesson for the cataract operator is that it is not enough to control the orbicularis by holding the speculum or by lid elevators or by injecting novocaine after the manner of Van Lint or of O'Brien. Squeezing should be prevented by good anesthesia including sedatives (basal anesthesia) or, if the patient cannot be trusted, if there is doubt in the surgeon's mind, by akinesis of the rectus muscle as well as of the orbicularis.

Physiological factors

Turning to the field of physiology, we find more changes—that is, more progress—than in anatomy.

The older writers had much to say about the mechanical factors in eye movements; Listing's law, for example.

Much attention was given (and still is in many quarters, I fear) to the action the individual ocular muscles would produce if one were to *act alone*. Since all ocular movements under normal conditions involve the coördinated action of all 12 extraocular muscles, it is an academic question how one alone would act, and its consideration is not only not practical but at times highly misleading. What we are really interested to know is the result when a muscle *fails* to act or when it acts abnormally, not when it alone acts. For example, the superior oblique is said to rotate the eye down and out when acting alone. Should all the nerves except the fourth be paralyzed, a rare condition, one could observe the action of the fourth alone when, for example, the patient tried to look down. In the common condition of a paresis of the superior oblique, the pathognomonic evidence is the lag when trying to look down and *in*, not down and *out*. A good example of unsound theory misleading, sound theory solid as a rock.

Better knowledge of the physiology of muscles in general has illuminated the physiology of ocular movement: the principle of *reciprocal innervation*, established by Sherrington 40 years age, anticipated by Descartes; the principle of *all-or-none* governing nerve and muscle fibers in their response to stimuli of different intensities; the principle of Hering that innervation to the ocular muscles to move the eyes is always binocular innervation and *equal in the two eyes*, enunciated by Hering years ago but not widely appreciated until more recently.

Fixation and fusion

The special topics of the physiology of ocular movements which I propose to discuss are fixation and fusion. First, consider monocular vision, the other eye being occluded. It is evident that the way the eye does its seeing is by looking at one thing after another in the field of view and looking at one point after another on a given object. This is fixation. Its purpose, of course, is to make the image of an object or part of an object which it is desired to scrutinize fall on the fovea, since the visual acuity of the fovea is vastly better than that of the periphery of the retina.

What is the neuromuscular mechanism required to carry out fixation? The mistake most commonly made is in limiting this mechanism to too few muscles and nerves and nerve centers. It is an extensive, elaborate, and extremely efficient reflex mechanism. If one wishes to look at a picture in a book—for example, a diagram of the anatomy of the eye and its connections with the brain—he does not fixate the center of the picture and take a long look, expecting to grasp all the picture has to convey to his intelligence. On the contrary, his gaze is shifting incessantly from one part to another. If the

picture is small—subtends an angle of less than 15 degrees—he can move his eyes to all parts of the picture by means of the 12 extraocular muscles. If the picture is larger than that, he will invariably move his head as well as his eyes, in order to reduce the excursion of the extraocular muscles. Thus fixation involves more than the six extraocular muscles of each eye. Or suppose he is out of doors. He hears a sound that attracts his attention, perhaps an airplane in the sky. He turns his head and even his whole body, tips his head back, raises his upper lids and eyebrows, and finally, after the image strikes the periphery of the retina, turns head and eye so that the image falls on the fovea. We are still considering one eye only.

In the simple case of reading a book, the eye shifts its gaze back and forth across the page, making several stops for fixation of a word or letter but taking in at each stop enough of the line so that only three to five stops are needed to read the line. With the eye in the primary position, the movements right and left are performed almost wholly by the lateral and mesial recti. But an indispensable part is played by the other four muscles in steadying the eye so that it follows the line accurately and moves down to the next line with precision. But suppose the book is shifted or the head turned, as in reading lying down. Then the eye does a satisfactory job with no fumbling, although often with more fatigue. But an entirely different adjustment is needed. The same muscles are used, but the share of each, hence the innervation of each, is different. What I wish to emphasize is the ability of the neuromuscular mechanism to execute the necessary movements not merely under ideal conditions, as when the eye is in the primary position, but under all sorts of complicating handicaps. For example, a prism suddenly placed before the eye changes the direction in which the line is seen but offers no obstacle to the eye in continuing the act of reading with the new adjustment. This, of course, is still more impressive when the two eyes are working together at the reading, and the prism is placed before one. That will be considered next.

What is the covered eye doing while this eye has been fixating in all directions? Every movement of the fixating eye has been followed under the cover by the other eye. The two eyes are a single organ (the binoculus). Innervation never goes to one alone but always to both, and equally to both. This fundamental law, first pointed out by Hering, has many important applications that cannot be considered now.

The coördination of the two eyes is not perfect, however. When the cover is removed while the fixating eye is still fixating some point, the image of this point is on the fovea of the fixating eye and should be on the fovea of the other eye if coördination were perfect. It never is. Some adjustment is always needed, but if it is very small it is disregarded as a diagnostic feature. Immediately on being uncovered, the images on the two retinas not being on corresponding points (one on the fovea, the other not exactly on the fovea), the person sees double and very quick corrective movements are made so that both are on their foveas before he realizes that there was diplopia.

If the person continues for some seconds to fixate the same point, are the eyes fixed and immovable? Minute examination shows that fixation is never steady. There are fine oscillations that are important physiologically but not significant in practice.

Suppose the person fixates the point and while doing so moves his head about. Compensating movements of the eyes keep the images always on the foveas, but

the compensating movement of the eyes does not occur *after* the movement of the head, it occurs simultaneously, showing that the *innervation of the muscles moving the head is an integral part of the neuromuscular mechanism for ocular movements.*

If a person is reading with both eyes and a prism, say 6$^{\Delta}$ base out, is placed before one eye, there is a momentary diplopia that is promptly eliminated by the necessary compensatory movements, and the patient goes on reading. But now a different innervation is used to move the eyes back and forth together than was required before the prism was introduced. Many persons can take care of a much stronger prism with immediate, efficient adjustment.

I am trying to place before you a picture of the neuromuscular mechanism for ocular movements that will convince you of its prodigious capacity to perform its functions, to make all sorts of adjustments—different amounts of convergence, different amounts of accommodation, acting with the visual plane horizontal, but equally well looking down or up, with the object in the midline equidistant from both eyes, or with the object to the right or left and nearer one eye than the other.

Then recall the cases in which a tumor, a swelling of some sort, displaces one eyeball right or left or up or down, thus making a very different innervation needed to move the two eyes about, and how often the patient is able to take care of a not inconsiderable displacement by his power of compensation, so that the neuromuscular mechanism functions efficiently.

The objective of these explanations now becomes apparent: If a person had one of the ocular muscles, for example the lateral rectus, attached (congenitally) a little nearer or a little farther from the cornea, would this anomaly offer an important obstacle to binocular vision and fusion? Suppose the external rectus were more slender than usual as compared with the other muscles; suppose the eyes were farther apart than usual, owing to the shape of the orbits and head. These and similar anatomical factors are taken care of by the neuromuscular mechanism in the vast majority of cases. If not, the fault is with some part of the neuromuscular mechanism, where the adjustments are usually made. The point is that anatomical factors are not the controlling ones in ordinary cases of heterophoria. Then what is? It is the "neuro" part of the neuromuscular mechanism. This is an extremely intricate maze of nerve cells and nerve fibers and their dendrites. The afferent messages from many sources, largely but not exclusively retinal, have to be received, coördinated, often inhibited, and finally converted into efferent motor messages to the muscles involved—ocular, of course, but also postural muscles of the neck and body.

It is not surprising that there should be defects in this part of the mechanism. It is essentially a reflex mechanism.

No one has emphasized this reflex mechanism so much as has Chavasse in his so-called seventh edition of Worth's "Squint." This book is distinctly not easy reading. The difficulties are not due to confused thinking or illogical presentation. They are due, in part, to the fact that we have not been accustomed to this new point of view; and, in part, to the fact that the author does not try to write in words of one syllable for beginners; also, in part, to his use of words to which we are unaccustomed or to which he imparts special meanings. I strongly urge you to study the book chapter by chapter. Do not expect to master his ideas and train of thought by skimming through it.

Before seriously studying Chavasse, study those sections of Duke-Elder's "Textbook" which deal with the same basal principles. For example, proprioception, exteroception, and the like (page 1082), based on Sherrington's "Integrative action of the nervous system," on Magnus's "Körperstellung," and on Pavlov's "Conditioned reflexes." Also the section on reflex movement (page 612), covering the fixation reflex, the fusion reflex, and the postural reflexes—static from the otoliths and from the proprioceptive nerve endings of the muscles of the neck, and kinetic from the labyrinth. These are elaborated and applied to squint and latent squint at great length by Chavasse. Unless we choose to ignore the epoch-making advances in physiology by Sherrington and his pupil, Magnus, and by Pavlov and his school, we must obtain a new grasp of the subject of ocular motility. We must rearrange our ideas. We must be dissatisfied with the old points of view of Stevens, Landolt, Maddox, Duane, and Peter. This does not mean abandoning the old but expanding it, thus throwing new light on the old established facts, explaining, interpreting, and above all diagnosing and treating. While I am on the subject of literature, let me tell you what are the most valuable sources, the richest veins of gold: Duke-Elder, without qualification; Chavasse, not without qualification but rich in ideas; Kurzes Handbuch; Helmholtz, American translation; Bielschowsky; current literature. Books by authors who have not themselves mastered the classics are often attractive, positive, definite, but, alas, not sound.

The next subject for discussion is the miscalled "position of rest." It has been assumed that it would be desirable to know what position the eyes would take if they were at rest. Of course they never are at rest, wholly relaxed, not even in deep sleep or narcosis. The ocular muscles like all striated muscles are in a state of tonus. This is reflex in origin.

The contraction of the muscles is not a continuous, steady contraction but consists of a succession of contractions, 60 or more a second. With a stethoscope applied to the eye the tone produced by these vibrations can be heard, as was first pointed out by Hering; hence, appropriately called *tonus*. With the string galvanometer and suitable electric connections, the currents in the motor nerves can be demonstrated and their intermittent rhythmic character shown and measured. One way of obtaining a stronger stimulus, aside from having a larger number of fibers stimulated at one time, is to have more frequent stimuli—75 or 100 per second, for example, instead of 50 or 60.

Since we have no way of determining the positions the eyes would take if all the extraocular muscles were for the time being absolutely relaxed, we must be satisfied with determining the position when certain stimuli are eliminated. The stimulus that can easily be eliminated is the fusion stimulus. This is accomplished in various ways; most effectively by occluding one eye. Under this condition only one eye can receive a retinal image and, of course, no fusion is possible, since this requires two images, one for each eye. Another means of eliminating fusion is by altering the image of one eye so that it does not lend itself to fusion but results in dissociation. For this a Maddox rod is commonly used. There are also various devices that can be employed in an amblyoscope, such as presenting a vertical line to one eye and a horizontal line to the other. The point where they intersect shows the deviation. Another way is to frustrate fusion by introducing an in-

superable obstacle, such as a prism too strong to be overcome, called the diplopia test and often combined with a red glass and a tangent scale. Another effective means is by the Lancaster red-green test in which the right eye, having a red glass before it, sees only a red spot projected on a screen, and the left eye, through a green filter, sees only a green spot, in a well-darkened room.

What shall we call the position the eyes assume under these conditions? It is customary to call it the *position of rest.* To escape the charge that the eyes are not in a state of rest, it is explained that it is a position of relative rest or a *relative* position of rest (Bielschowsky), or a position of *comparative* rest (Chavasse). When this has been explained, the term can be used without much confusion, but the tendency is to give the impression to the student that the eyes *are* at rest. Since it is perfectly easy and simple to use words that do not have to be qualified or explained away, why persist in using the term "position of rest" or even "relative position of rest," or "anatomical position of rest," and so emphasize a supposed mechanical or anatomical basis for the position?

Other terms proposed are: "fusion-free" position (Hofmann). This seems clear without misleading implication. Chavasse objects to it, stating it is not so much "fusion-free" as "fusion frustrated." This objection does not seem to me to carry much weight. Chavasse prefers the term "dissociated position." This term is good especially for the position as determined by the Maddox rod, red glass, and other means, methods which do not wholly eliminate one eye as does occlusion, cover, screen, blind. Many additional arguments might be cited against trying to explain the phoria position as an anatomical or mechanical position of rest. For example, in a case of double hyperphoria, whichever eye is covered in the screen test deviates up under the cover. Obviously this cannot be explained on an anatomical, mechanical basis; for were the eyes "at rest," if the right deviated up under cover the left would deviate down when it was covered. Another phenomenon easily explained on the assumption that in measuring a phoria we are measuring the position the eyes take under the influence of various "neuro" factors (essentially various more or less complicated reflexes, the fusion reflex being eliminated) is the variability in the amount of the phoria at different times and under different conditions, different tests sometimes even showing a different direction of deviation, now esophoria, now exophoria, now hyperphoria.

The most effective and reliable way to determine the position in question is by blinding one eye with a cover that wholly excludes it from seeing but leaves it, of course, subject to the innervation induced by the act of fixation by the other eye. This is the "fusion-free" method, and since the position so determined is the correct measure of the deviation, why not use this term, in preference to "dissociated position," which is especially fitted to designate the less reliable position determined by the Maddox rod, and such tests? Fischer uses the term "Abblendungsstellung." This is a very good German term but not so good in English because no accepted translation is in use. It is rather misleadingly translated "blind position" by Duke-Elder. "Blindfold position" or "covered or screened position" would be less misleading. So I prefer on the whole the excellent term "fusion-free position." It calls attention to the essence of the thing we are talking about; namely, the position that the eye takes under the stimulus of fixation (monocular) but without the stimulus of fusion (binocular).

What is the value of this measurement? Note that it is a measurement of an actual deviation that occurs when fusion is prevented; it is not merely a *tendency* to deviate. It is important because it shows what motor task fusion has to perform in bringing the images upon corresponding retinal points. Thus, if there is an exophoria of 6$^{\Delta}$, the task of fusion is to make the eyes take on 6$^{\Delta}$ more convergence = 6$^{\Delta}$ less divergence, so that there will be no deviation but that binocular single vision may result. The measure of the deviation is the measure of the corrective movement in the opposite direction that is required. Thus if there is an esophoria of 10$^{\Delta}$ its correction in order to produce fusion calls for a divergence of 10$^{\Delta}$. These corrective movements are all disjunctive movements, not conjugate; that is, the two eyes do not move in the same direction but in opposite directions—more convergence or more divergence or more sursumvergence is called for. Note

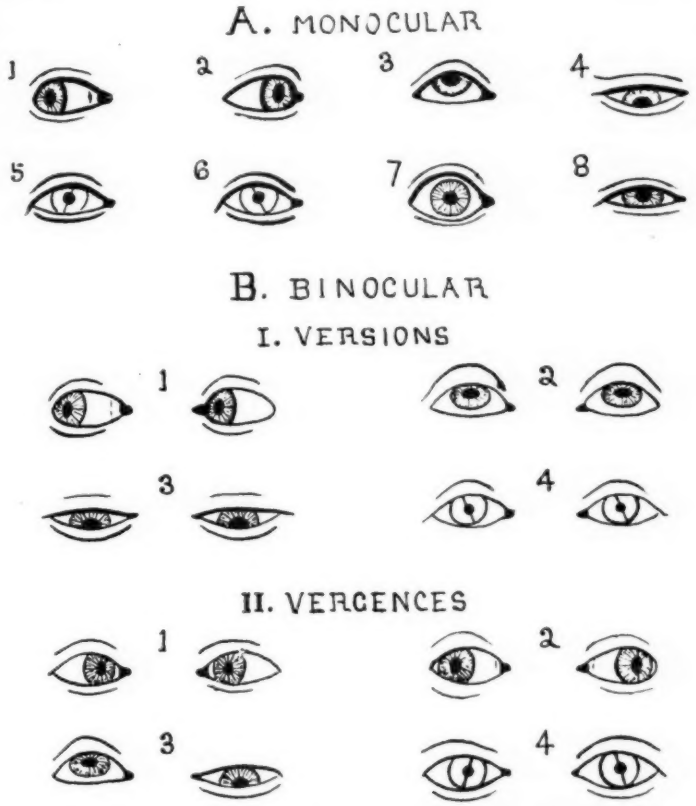

Fig. 2. From Worth, by Chavasse (Lancaster). Terminology of ocular movements. A., Monocular, of the right eye: 1, abduction; 2, adduction; 3, elevation; 4, depression; 5, intorsion; 6 extorsion; 7, protrusion; 8, retraction.

B., Binocular. I. Versions: 1, dextroversion (laevoversion similarly); 2, sursumversion; 3, deorsumversion; 4, dextrocycloversion (laevocycloversion similarly). II. Vergences: 1, convergence (horizontal); 2, divergence (horizontal); 3, right positive vertical divergence (right negative divergence similarly); 4, conclination (disclination similarly).

that all disjunctive movements are *vergences* while all conjugate movements are *versions*—dextroversion, levoversion, and so on (fig. 2).

What, then, are ductions? Ductions are movements of one eye in disregard of what the other is doing (preferably under cover). Adduction is rotation of an eye toward the midline of the body as it is of all other movable parts, arm, leg, and so forth, or in the case of the thumb or toe toward the middle of the hand or foot. Abduction is movement away from the midline. Thus when the right eye performs the movement of abduction, the left, if not paralyzed, performs a movement of adduction. When it is wished to discriminate between the superior and inferior rectus and oblique muscles as elevators and depressors, the rule is that the vertical recti have their maximum action when the eye is in abduction, the obliques when the eye is in adduction. Obviously it would not do to use adduction and convergence synonymously in this case. Why use them synonymously at all? Apparently, it was first used extensively by optometrists, then ophthalmologists fell into the habit, and we find Peter and Verhoeff and an increasing number confusing adduction with convergence. Chavasse devoted a page (51) to defining the terms, and he uses them correctly as they have come down to us from the masters—Duane, Stevens, Landolt, Bielschowsky. It was interesting to note that after Bielschowsky had been in America a few months, I found he had fallen into the habit of misusing these terms in English, showing the influence of the widespread American usage.

The usage has become so widespread of calling prism convergence, prism divergence, and prism sursumvergence "prism ductions" that any attempt on my part to stem the tide will be futile; even Chavasse uses this term, although "prism vergences" is easier for the beginner to learn and quite as easy to say or write.

(To be continued)

ORBITAL TUMORS AND THEIR SURGICAL TREATMENT*

PART II

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One hundred seventy-four consecutive cases of unilateral exophthalmos arising from tumor or tumorlike lesions, verified by biopsy or other means, were analyzed with particular regard to differential diagnosis, incidence of various lesions, types of treatment indicated, and prognosis. The causal lesion may be: (1) primary in the orbit (63 percent of this series), (2) in the region adjacent to the orbit (29 percent), or (3) systemic (8 percent). The proportion of extraorbital and distal lesions may be unduly high in this series as it was compiled in part from cases seen at the Memorial Hospital for the Treatment of Cancer and Allied Diseases.

Of the causal lesions primary in the orbit 87 percent were confined to seven types which in the order of their frequency were hemangioma, pseudotumor, meningioma, dermoid and epidermoid cysts, sarcoma, neurogenic tumors, and mixed tumors of the lacrimal gland. In the first installment of this paper, which appeared in the previous issue of this Journal, these conditions were discussed.

In this issue, the subject is continued with a consideration of the causes of exophthalmus from tumors or tumorlike lesions contiguous to the orbit and from systemic and distal lesions. The subject of biopsy and, finally, the various surgical procedures indicated are discussed.

EXOPHTHALMOS FROM LESIONS ADJACENT TO THE ORBIT

From newgrowths in nasopharynx		19
From newgrowths in sinuses		
Antrum	12	
Ethmoids and/or sphenoids	3	
Ethmoids	2	17
From malignant melanoma of choroid		
Extension from eye to orbit	2	
Recurrent after enucleation	5	7
Extension of epithelioma from lower lid into orbit		
Basal cell (1 no exophthalmos)	3	
Squamous cell	1	4
Chloroma		1
From newgrowth of hard palate		1
From nose to orbit *via* tear sac		1
Metastatic carcinoma to uvea with orbital extension		1
Total		51

Nasopharyngeal lesions. The commonest cause of exophthalmos from extension of an extraorbital lesion is a newgrowth originating in the nasopharynx. It is anaplastic in nature and may be transitional-cell carcinoma, lymphoepithelioma, or lymphosarcoma. According to Martin, these tumors advance through the foramen lacerum, come in contact with the internal carotid artery lying in the carotid groove, and extend along this vessel and groove to the superior orbital fissure, through which they enter the orbit.

The primary site is usually on the posterior wall in the region of the nasopharyngeal tonsil and its lateral extension into the recessus pharyngis, and less frequently on the lateral wall. The primary site may still be quite small, even small enough to be overlooked (especially when it is in the fossa of Rosenmüller), after the tumor has already produced orbital symptoms or exophthalmos.

Sinus lesions. Newgrowths of the sinuses that produce exophthalmos do so by direct extension into the orbit. These are also in the nature of anaplastic tumors, which may be transitional-cell carcinoma, lymphoepithelioma, or lymphosarcoma. In this series the antrum was the commonest primary site of lesions producing exophthalmos, probably because the antrum is the sinus most commonly

*From the Institute of Ophthalmology of The Presbyterian Hospital and Memorial Hospital for the Treatment of Cancer and Allied Diseases.

affected with cancer. Cancer of the ethmoid in all likelihood leads to exophthalmos in a high percentage of cases because (1) only the thin bony lamina papyracea separates the ethmoids from the orbit, and (2) cancer of the ethmoid is frequently associated with infection which sometimes produces an orbital cellulitis.

Eye and lid lesions. Exophthalmos that occurs from the extension of a newgrowth in the eye or lids is usually not difficult to explain. An exception to this in this series was a case of malignant melanoma of the choroid which became necrotic and in which the necrotic tumor tissue gave rise to a severe panophthalmitis with orbital cellulitis clinically resembling a lesion produced by infection. The interior of the eye could not be seen and the underlying cause could have been overlooked.

The three groups described above comprise 90 percent of the cases of exophthalmos caused by lesions adjacent to the orbit.

EXOPHTHALMOS FROM SYSTEMATIC OR DISTAL LESIONS

From metastatic newgrowths		
from breast (carcinoma)	3	
from suprarenal gland and/or retroperitoneal region (sympathicoblastoma, neuroblastoma)	2	
from thyroid (carcinoma)	1	
from lung (lymphosarcoma)	1	
from tonsil (carcinoma) to orbital bone	1	
from unknown site (carcinoma)	1	9
Hodgkin's disease:		
to lacrimal gland (no exophthalmos)	1	
to orbital bone (no exophthalmos)	1	2
Lymphatic leukemia		1
Schüller-Christian disease		1
Gumma		1
Total		14

DIAGNOSTIC PROCEDURE

The differential diagnosis of unilateral exophthalmos with respect to etiology is simplified by the fact that a large proportion of cases arises from a relatively small number of causes. In reviewing the literature on the subject of orbital tumors, one encounters a maze of terms giving the impression that the types of tumors that occur in the orbit are legion and that the subject is very complex. For instance, a meningioma may be called "psammoma," "endothelioma," "fibroma," "arachnoblastoma," and so on, and a mixed tumor of the lacrimal gland may be called "cylindroma," "adenocarcinoma," "adenoid cystic-epithelioma," "adenoma," "myxochondrocarcinoma," and so on. The important fact remains that each group, regardless of the varied names by which the tumor comprising it is designated, has its specific clinical characteristics, course, treatment, and prognosis. In this series, 147 cases or 85 percent were traceable to only 12 different types of lesions.

X RAY

A roentgenologist can be of immense help in differentiating these orbital lesions, particularly if he is also an ophthalmologist or is familiar with this particular problem. X-ray studies are also extremely helpful in determining the course of treatment and prognosis, particularly in showing whether or not bone invasion is present in cases of meningioma and mixed tumor of the lacrimal gland, and in indicating the character of the optic foramen, which frequently signifies whether a meningioma or a glioma of the optic nerve remains entirely in the orbit or has extended into the cranium.

BIOPSY

In many instances a biopsy is necessary for diagnosis. It is generally believed that the removal of a piece of tissue for this purpose from a surface lesion does not tend to produce metastasis or to increase

local dissemination. Orbital lesions, however, lie deep beneath intervening normal tissue and are usually encapsulated. In such cases biopsy by surgical incision may require some dissection into important normal structures and may be followed by unfavorable consequences on the course of the growth. Ewing's objections to surgical biopsies in such instances are that the procedure modifies the clinical setting, breaks down the natural local barriers, favors fungation of the growths through the opening in its capsule into the surrounding normal tissue, and in some instances encourages metastasis. These objections, of course, are less valid when the indicated therapeutic measures are carried out without delay.

Aspiration biopsy. In many instances surgical biopsies can be avoided by employing aspiration biopsy. By this method, advocated by Martin, it is possible to obtain a histological diagnosis of a tumor in a very short time, and the procedure may be carried out in the clinic or the office under local anesthesia. The pathologist cannot be expected to give as much information from such biopsies as he can from larger pieces of tissues, but it is possible to say in most instances whether or not the tumor is malignant and often what type of tumor it is, particularly if the pathologist has the clinical data at hand and is familiar with the tumors that are to be encountered in the orbit. A granuloma may be diagnosed in this way, and if only blood is aspirated from several sites, a hemangioma can be assumed. A negative report, on the other hand, has little diagnostic value. In a series of over 3,500 cases in which aspiration was done at the Memorial Hospital, including material from such regions as the lungs, liver, spleen, prostate, and neck, as well as from the orbit, there have been no untoward sequelae in the form of local damage or of proof of increased local invasiveness or earlier or more frequent metastasis.

The equipment required is an ordinary 18-gauge needle, 5 to 10 cm. in length, and a 20-c.c. record syringe. Glass slides are necessary for smearing the specimen, and a specimen bottle with 10-percent formalin is needed if a portion of the tissue is to be treated as regular biopsy material.

The technique is to inject novocain locally and make a small incision through the skin at the site of the intended puncture. This opening in the skin facilitates the insertion of the needle and prevents contamination of the aspirated material by surface epithelium. The needle attached to the syringe with the piston closed is inserted until the point is felt to engage the suspected lesion, the piston is partly withdrawn to produce a vacuum, and the needle is then advanced further into the lesion. With the vacuum maintained throughout, and with the point of the needle always within the tumor, the needle is withdrawn somewhat, advanced again, and again somewhat withdrawn. Tissue from the tumor mass enters the needle and is held there by the vacuum. Before the needle is withdrawn completely the piston must be released slowly and the syringe detached. The needle is then withdrawn separately and its contents are slowly expelled onto a glass slide. The material may be prepared for examination either by making a smear and staining immediately or by treating the small piece of tissue as regular biopsy material.

Surgical biopsy is usually a simple procedure technically, especially when a mass is palpable near the surface, but it may be unsatisfactory when there is no indication of the location of the lesion in the orbit. Approaching the lesion through the upper lid should be avoided whenever possible. If such a route is indicated, precautions should be taken to avoid the levator muscle.

A note of warning should be sounded regarding the removal of biopsy tissue in cases of pseudotumor. Because of the vascular changes occurring in this lesion, the tissue tends to bleed profusely. This is a general bleeding and upon one occasion in the writer's experience it was necessary to pack the wound and do a secondary closure. If the bleeding in these or in any other cases is great, so that there is sufficient dissemination of blood throughout the orbit to provoke an increase in the exophthalmos and endanger the cornea from exposure, then the lid margins should be made to adhere, and a very firm pressure dressing applied.

Surgical biopsies are particularly contraindicated in cases of mixed tumors of the lacrimal gland, especialy when the proposed treatment is not to be carried out immediately.

Surgical procedure

Surgical treatment of unilateral exophthalmos consists of one of three procedures. These are (1) local excision of the lesion, (2) enucleation combined with local excision, or (3) exenteration of the orbit.

Local excision of lesion. For the successful local excision of an orbital lesion it must be well localized or encapsulated. Lesions that may fulfill this requirement are hemangioma, meningioma, dermoid cyst, mixed tumor of the lacrimal gland, neurinoma, lymphoma, hematoma, fibroma, lipoma, lymphangioma, and glioma of the optic nerve.

When these lesions recur after incomplete removal they usually become increasingly more diffuse and disseminated. This is particularly true of the mixed tumors of the lacrimal gland which seem after each incomplete surgical excision to become more locally destructive, invasive, and metastogenic. They tend to recur even when so well encapsulated that a complete removal has been anticipated at the time of original excision. Sanders attributes this extremely high recurrence to the tendency of the tumor to invade the bone and to the fact that when it is removed by being "shelled out" of the capsule, tumor tissue that has invaded the capsule apparently remains behind. In these cases, therefore, the excision should be as wide as possible. If the tumor is invasive an exenteration is indicated, and if there is bone involvement the bone should be resected if possible.

Sometimes the capsules of the various lesions adhere to adjacent structures. In the case of the extraocular muscles this may cause injury when the lesion is removed without the globe. This is particularly true of the meningioma which lies in the apex of the muscle funnel in direct relationship to the extraocular muscles. When one or more of these muscles are injured in this way it may be advisable to fix the eye in the primary position so that the repair tissue formed later in the orbit around the globe will fix it in good alignment and with no proptosis. This can be accomplished by passing a silk suture through the lid margin and through the episclera at the limbus, nasally and temporally, and tying over the surface of the lids. A tenotomy of the opposing muscle may also be advisable.

The location of a lesion in the orbit determines its accessibility for removal. It may be located in the muscle funnel, as are meningioma and glioma of the optic nerve, but the majority of lesions are outside the muscle funnel and, luckily, are located temporally so that they can be very satisfactorily approached by a transconjunctival route, in the following manner: A canthotomy is performed and the fibers of the external canthal ligament, together with the tarsoörbital fascia, are divided. The conjunctiva is incised along the fornix to the vertical meridian above

and below the canthotomy. This conjunctiva is dissected free. If the tumor is in the muscle funnel, the external rectus muscle must be severed at its insertion. By retracting the globe nasally, very good access to the orbit is obtained. In our experience any lesion can be removed as satisfactorily in this manner as by the Krönlein method. If a little more exposure is needed some of the margin of the bony orbit temporally can be removed with rongeur forceps, without causing any cosmetic blemish, but this additional procedure is rarely necessary.

The temporal transconjunctival approach gives sufficient access to the orbit for the removal of tumors located anywhere but nasally. When they occur nasally, neither this approach nor the Krönlein procedure is satisfactory because, if the muscle funnel must be crossed in approaching the lesion, there is such extensive damage to the extraocular muscles, the posterior ciliary vessels and nerves, and the optic nerve that it is not feasible to attempt to retain the globe. If the lesion is definitely in the nasal side of the orbit, it should be possible to use the same transconjunctival approach nasally, although I never have had occasion to do so. The reason why practically all lesions are approachable from the temporal side is that there is very little orbital space nasal to the muscle funnel. The internal rectus and optic nerve course very close to the nasal orbital wall.

In cases of tumor of the optic nerve (glioma or meningioma) it may be advisable in rare instances to excise the tumor, leaving the globe *in situ*. The transconjunctival approach can be used, the external rectus reflected, the tumor excised at the apex of the orbit, and the globe with the tumor attached everted by extreme rotation of the eye. This gives satisfactory exposure for excision of the tumor from the globe. Fortunately, the tumor frequently leaves about 2 mm. of unaffected nerve adjacent to the globe and this is sufficient to permit the excision of the nerve from the globe free of tumor tissue.

Small lesions located in the region of the lacrimal gland can be approached satisfactorily through the outer third of the skin of the upper lid. Care should be taken to avoid any injury to the levator muscle.

Enucleation with local excision. Occasionally when the orbital lesion is extensive but localized, or inaccessible for local excision leaving the globe *in situ*, it is well to enucleate and then perform an excision so that the patient may later wear an artificial eye.

Exenteration. An exenteration of the orbit is indicated in extensive involvement with any tumor, in all cases of sarcoma except lymphosarcoma, which is quite radiosensitive; in diffuse extensive recurrence of an excised tumor; in extensive orbital extension of an intraocular tumor; and, rarely, in orbital involvement secondary to a newgrowth of the nasopharynx, sinuses, or lids in order to facilitate irradiation or to relieve pain.

In performing the exenteration, the skin of the upper and lower lids is left intact. The skin of the upper lid is inverted upon the roof of the orbit and the skin of the lower lid is used similarly to cover the floor of the orbit. If the remainder of the orbit is allowed to granulate, discharge occurs over a long period of time and frequent dressings are required, sometimes for several months. As recommended by Kirby, a Thiersch graft placed in the orbit at the time of the exenteration will take readily on the bare, deperiosteomized bone and leave a clean, nondischarging, odorless orbit one week after the operation.

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Miss Lily Kneiske has given great assistance in compiling the data.

MONOCULAR DIPLOPIA*

Report of a case

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Diplopia in binocular individuals is frequently encountered, whereas diplopia in monocular individuals is exceptionally rare in occurrence, and its etiology presents a baffling problem.

Butler[1] reported a case of monocular diplopia in a male, aged 54 years, who had been struck in the right eye 30 years before. In the lens he found a large fluid cleft occupying the whole depth of the cortex, being bounded anteriorly by the subcapsular line and posteriorly by the surface of the adult nucleus. This cleft formed an optical opacity dividing the lens into an upper and a lower segment. The two segments functioned independently, forming an upper and a lower image on the retina.

Agnello[2,3] cited the occurrence of monocular diplopia in two cases. In one patient the uniocular diplopia followed the appearance of parenchymatous keratitis. The second patient became conscious of uniocular diplopia at the onset of her menopause.

Negre[4] presented a case in which monocular diplopia occurred secondary to a large retinal detachment with inferoversion of the retina.

In Gerstmann and Kestenbaum's[5] cases the monocular diplopia was said to have been caused by such cerebral diseases as encephalitis lethargica, postencephalitis, multiple sclerosis, and basilar meningitis, while in Klein and Stein's[6] case the monocular diplopia and triplopia (binocular) occurred in a patient who had a cerebellar tumor.

The clinical picture described below is of interest because the diplopia is found in a monocular individual who presents none of the above-mentioned abnormalities or diseases.

Case report

G. F., a white adult male, aged 50 years, was admitted to the Neurosurgical Division of the Kings County Hospital on July 19, 1936, because of a large ecchymosis involving both eyelids of the right eye and the right maxilla. There was moderate proptosis of the right eye, a massive subconjunctival hemorrhage, and a complete hyphema of the anterior chamber. The patient had been drinking and was beaten.

At the time of admission to the hospital he was in an alcoholic stupor. The neurological examination revealed no abdominal, ankle, nor cremasteric reflexes. The Babinski reflex was negative. A spinal tap revealed clear fluid. X-ray studies revealed the presence of "a comminuted fracture through the body of the right zygomatic bone with the fragments in satisfactory alignment. The right maxillary sinus was cloudy, most likely secondary to hemorrhage in this region. There was no evidence of a fracture of the vault of the skull."

The patient was transferred to the ophthalmological service.

The only point of interest about his past history was that he had sustained a skull fracture resulting from a fall. This occurred 24 years before the present ad-

* From the Ophthalmological Service of Dr. W. Moehle, Kings County Hospital. Read before the Brooklyn Ophthalmological Society, October 17, 1940.

mission. Deafness of the left ear had resulted from this accident, but the patient had suffered no injury to his eyes in any way, so far as he was aware. He never had seen double. He had no squint.

His occupation was also of interest: he was a house painter. However, he had

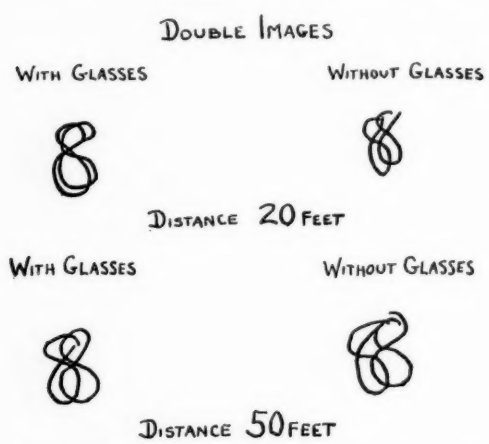

Fig. 1 (Pincus). Monocular diplopia, increasing as the object recedes.

been unemployed for four years previous to the emergency that brought him to the hospital.

The ecchymosis of the lids and the proptosis of the right eye subsided. The anterior chamber remained filled with blood. There was no light perception in this eye. Two months after the date of admission, the patient developed a painful acute rise in intraocular pressure of the affected eye, and because we were dealing with a painful blind eye, an enucleation was performed.

Shortly after the enucleation of the right eye, the patient became conscious of seeing double images with his left eye, and of a scotoma temporal to his point of fixation.

This patient has been under observation for four years and these symptoms have not abated. Complete general surveys, including laboratory studies, have subsequently been made. They have revealed nothing of significance other than an eighth-nerve deafness of the left ear and X-ray findings of a moderate clouding of the right ethmoid and the maxillary sinuses. Antrotomies were performed, but no frank purulent secretion was obtained. Numerous neurological examinations were made at intervals, but never revealed abnormal findings.

He was seen in the ophthalmological clinic many times. The findings were always as follows:

The lids revealed no abnormalities. The conjunctival socket of the right eye was clean and healthy in appearance. The prosthesis fitted well. The examination of the anterior segment of the left eye with focal illumination and the slitlamp disclosed a small superficial nebulous opacity at the lower nasal limbus of the cornea. The anterior chamber was normal in depth. The pupil was round, free, and reacted well to light and to accommodation. There were no abnormalities in the iris or lens. The media were clear throughout. The optic disc was in every way normal. The blood vessels were normal in caliber. Neither the macula nor the remainder of the fundus showed abnormalities.

Vision was: O.S. 6/21; with correction, 6/9.

The patient was wearing a —1.25 D.cyl. ax. 30°.

The intraocular tension (Schiötz) of the left eye was 21 mm. Hg.

The perimetric (quantitative) and the campimetric studies revealed no abnormalities. After a most thorough search no scotoma in the peripheral or central fields was found. Angioscotometric studies revealed no pathological changes.

Pictures of the double images as seen by the patient are presented. This clearly indicates that the farther the object is from the eye the more displacement there is between the real and false images.

Discussion

In order clearly to analyze the problem which this patient presents it is well to outline the most commonly accepted causes for diplopia in one eye.

A. Corneal pathology: (1) irregular corneal astigmatism;[7] (2) high degree of corneal astigmatism;[7] (3) parenchymatous keratitis.[2]

B. Double pupil (only if the accommodation is relaxed),[8] whether: (1) traumatic;[8] (2) inflammatory;[8] or (3) developmental.[8]

C. Lens pathology: (1) irregular lenticular astigmatism;[7] (2) developing cataract;[7] (3) partial dislocation of the lens in the pupillary area: (a) traumatic,[7] (b) developmental;[7] (4) fluid cleft (traumatic).[1]

D. Vitreous pathology: (1) opacities: (a) unabsorbed hemorrhage,[8] (b) cysts (echinococcus, and others),[8] (c) salt crystals (cholesterin, and others);[8] (2) foreign bodies: (a) air bubble,[8] (b) droplet of oil,[8] (c) glass.[8]

E. Retinal pathology: (1) macular pathology (cyst);[8] (2) retinal detachment.[4]

F. Intracranial pathology: (1) encephalitis lethargica;[5] (2) postencephalitis;[5] (3) multiple sclerosis;[5] (4) basilar meningitis;[5] (5) cerebellar tumors.[6]

G. Endocrine pathology: (1) menopause.[3]

H. Psycho-pathology: (1) hysteria.[9]

I. Simulation (malingering).[9]

Monocular diplopia may therefore result from pathological changes in any part of the mechanism of "seeing."

During the past four years this patient has been under observation continually and with the exception of the finding of a small superficial nebulous corneal opacity at the lower nasal limbus and a small degree of corneal astigmatism, neither of which can possibly cause double vision, nothing was ever found that could explain his curious symptom. The patient is also conscious of a scotoma slightly temporal to his point of fixation. This scotoma is his "blind-spot." Repeated examinations have failed to reveal any other scotoma. All the usual accepted physical or "organic" causes for monocular diplopia have been looked for and found absent. Numerous complete neurological examinations failed to reveal any abnormalities of a fixed or progressive nature in his central nervous system.

Because organic causes were found to have been lacking, it was natural to turn to psychic disturbances as an explanation of this symptom. Hysteria has been noted as one of the causes of monocular diplopia. In this patient there may be some basis to warrant the consideration of a "functional" central-nervous-system disorder as an etiological agent of the complaint. He is unemployed and has been so for many years. He has lost an eye. He therefore has cause for the development of hysterical symptoms, but his symptom manifestation does not conform to that which competent observers find in hysteria.

Evans[8] states that in the diplopia of psychic origin the separation of the images is not greater the farther the object is removed from the eye of the patient. In this patient the images are definitely further apart the farther the object is from his eye. Whether this is sufficient ground to dismiss hysteria as the cause of the diplopia or not, cannot be definitely stated. It is of interest, however, to note that during the period of observation this patient at no time showed any other symptoms traceable to a hysterical personality.

Since this symptom offers the patient no conceivable benefit, malingering has been definitely ruled out as a possibility.

Conclusion

The circumstances are described which attend a patient with one eye whose com-

plaint is diplopia. Known etiological factors for the production of monocular diplopia are enumerated, none of which are pertinent as etiologic factors in this case. The patient has been under observation for four years and, so far, no reasonable cause has been established to explain his condition.

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A SCOTOMA ASSOCIATED WITH MENSTRUATION*

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The first studies of a scotoma associated with menstruation were made in 1932.[6] Even at that time it was suspected that interpretation would depend on a comparison between phases of the defect and various events of the menstrual cycle. A supplementary study is now presented to permit such a comparison. The paper is divided into a general review of the menstrual phenomena and a presentation of the material of this study.

THE MENSTRUAL CYCLE

A review of the basic manifestations of menstruation as presented in modern works of the physiology of the subject will help to keep before us the essential phases of the phenomenon.[1]

"Bleeding from a distintegrating uterine mucosa which has undergone a definite preparation, accompanied by development of the Graafian follicle, ovulation, and consequent corpus-luteum formation in the ovary," constitutes the menstrual cycle.[1] It is obvious that the actual appearance of the flow cannot be the true beginning of the cycle, yet the appearance of the bloody discharge on the first day of the cycle has come to be so designated.

DURATION OF CYCLE

The cycle in different subjects may vary from 18 to 42 days. Marked irregularity in the length of the cycle of different women existed in two thirds of one large series studied. The length of the cycle for individuals is fairly constant, but variation of the duration of the active flow is not uncommon. The average duration of the flow is generally considered to be from three to six days.

TIME OF OVULATION

There are no classic signs that designate the time of ovulation. At present it seems generally agreed that liberation of the ova from the Graafian follicle occurs from the twelfth to the eighteenth day.**

SYSTEMIC CHANGES

A great deal of work has been done on the systemic changes associated with the menstrual cycle, but according to Fluhmann, there has been so much disagreement in results that we are in possession of but little positive evidence. Some workers have observed—and others have not—premenstrual or menstrual variations of temperature, blood pressure, pulse rate, blood calcium, blood potassium, blood arsenic, blood cholesterol, and blood lecithin. There has been no unanimity of opinion on changes in the composition of the circulating blood during menstruation. Some observers found, diminution of the red blood cells, reduction of the hemoglobin, increase of blood platelets, diminished coagulation time, and hypoglycemia. Studies on the basal metabolic rate have been equally inconclusive. Certain urinary changes occur, for instance, a marked rise in the ammonia coefficient not due to increased total nitrogen; and there is a marked increase in cholin in the perspiration. It is thus

* From the Long Island College of Medicine and the Long Island College Hospital, Department of Ophthalmology. Read before the American Ophthalmological Society at Hot Springs, Virginia, June, 1940.

** With a 28-day cycle, the "conception period" would be from the eleventh to nineteenth day, therefore the "safe period" would fall before and after these dates.

obvious that we cannot hope to discover a relation between these debatable reports and the changes of the scotoma.

Water metabolism

When we consider certain aspects of the water metabolism of the menstrual period, there is, however, more encouragement.

During the menstrual period there is frequently evidence of generalized edema, increased permeability of the capillaries, local turgescence of the mucous membranes—notably of the nose—and a retention of sodium chloride and water. One third of all normal women are said to gain up to three pounds or more in body weight during the premenstrual phases. This increased retention of water and sodium chloride is believed to be due to the influence of ovarian hormones.

Estrogenic substances reach a peak of concentration in the blood during the seven days preceding ovulation.

Modern research appears[2] to have demonstrated conclusively that estrogenic substances affect the venous and capillary pressures. The lowest venous and capillary pressures occur just premenstrually, and coincide with the peak of estrogenic bodies in the blood.

Although much is known about oxygen consumption and various other aspects of tissue metabolism during the menstrual period, as regards the human, our knowledge appears to be too uncertain as yet for us to seek a relation between the described scotoma and such changes in the tissues as a whole.

Analysis of the ovulatory cycle for purposes of comparison with scotoma phases is necessary if correct conclusions are to be drawn. Fluhmann divides the cycle into six stages. The appearance of the first flow is considered as "day one."

I. First to fourth day: Desquamation of endometrium—called the "state of desquamation."
II. Third to fifth day: Endometrium heals and the follicle develops—called the "stage of regeneration."
III. Sixth to fourteenth day: Follicle matures and the endometrium proliferates—called the "estrogenic phase."*
IV. Fourteenth day: Escape of ova into the tube—called the "ovulation phase."
V. Fourteenth day to twenty-fifth day: Corpus luteum present—called the "progestin phase."†
VI. Twenty-fifth to twenty-eighth day: Degeneration of corpus luteum—called the "premenstrual stage."

In the careful studies which Brewer[3] has made, a gradual increase in the fragility of the peripheral capillaries was demonstrated. This increase began in the late premenstrual period and reached a peak in the first or second day of the flow. By the second or third day after the flow had ceased, the capillaries had returned to the more resistant condition found during the intermenstruum.‡

This classical pattern of reaction in the peripheral vascular system takes place at the approximate time of menstruation, regardless of variations in the lengths of the menstrual cycle or the menstrual flow. There were modifications of the pattern, such as one would expect in any biological phenomenon.

Brewer§ quotes Hagen to the effect that with the aid of the microscope he observed capillary spasm during the pre-

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* Estrogen produces proliferation of endometrium in preparation for the ovum. It arises from many tissues besides the ovary.

† Progestin prepares the uterine mucosa for the fertilized ova. It originates in the corpus luteum.

‡ Brewer's tests were made in the cubital and infraclavicular spaces by means of a powerful negative-pressure device.

§ The writer is familiar with the mild controversy which the work of Brewer has stimulated. His work would seem acceptable, however, until others can present contradictory data, after meticulously adhering to his technique.

menstrual period. He also quotes Landis as declaring that this vasospasm produces an anoxemia of the capillary endothelium, which results in increased permeability.

Scotometry of Menstruation

Scotometry with minute objects used at a short fixation distance has in recent years been productive of results not previously attained. In an effort to ascertain the field of usefulness of this technique, planned studies of various physiological states have been undertaken and the results corroborated by many workers. Those conditions in which vascular phenomena predominated developed the most interesting results, and offered opportunity for more advanced investigation. Menstruation, as a classical physiological vascular event, was selected for this special study. The data collected are presented here:

Source of material. Most of the patients studied were selected from private practice, although a few were dispensary patients. Every effort was made to be certain that the patients were in good health and particularly that they were free from such conditions as experience had demonstrated might be associated with visual-field defects. Vigorous young women, rather than more mature subjects, were selected. None had borne children or had suffered from gynecologic disburbances except as indicated in the text. Careful ophthalmologic examination had been made in each instance, and the significance of the study was explained to the patient so that she would not become apprehensive. In a few cases quantitative visual-field studies were made, both at the height of the menstrual period and during the intermenstruum.*

Technique. The technique employed was that advocated for angioscotometry and described elsewhere.[4] The main difference in this technique, as distinguished from that used for ordinary scotometry, lies only in the emphasis that was laid on minute objects (0.25-mm. to 0.1-mm. objects) used at a short fixation distance (190-mm.) and moved slowly from seeing to blind areas at right angles to the assumed border of the defect. As elucidated elsewhere,[4] the short fixation distance is essential to reduce the effect of the "normal nystagmus," or fixation movements. The actual size of the object is important, the angular size of the objects being relatively large.

The study was limited to 25 degrees about the fixation area, as indicated on the appended charts. For convenience of review, the collected material has been arranged in the following groups:

Group I: This constituted 88 studies made on 22 subjects. A plotting of each eye was made at the height of the menstrual flow, and a second study of each eye was made between the menstrual periods. Central visual acuity tests, blood-pressure recordings and fundus examinations were made at each visit. An effort was made to ascertain the possible influence on the menstrual flow and scotoma of respiratory infections, medication, fatigue, constipation, and similar episodes.

Of the cases studied in this group, 100 percent showed a defect in the superior field during the menstrual period, which cleared up during the intermenstrual period.

This finding seemed to require more detailed study in order to demonstrate the scotoma variations as compared to the various phases of the menstrual cycle. To this end a second, more comprehensive series was arranged.

Group II: There were 150 studies made of five subjects. These plottings of the

*The writer wishes to thank Dr. Charles Rosenthal, Dr. Henry Abbott, and Dr. George Graham for their coöperation in carrying out many of the more tedious studies.

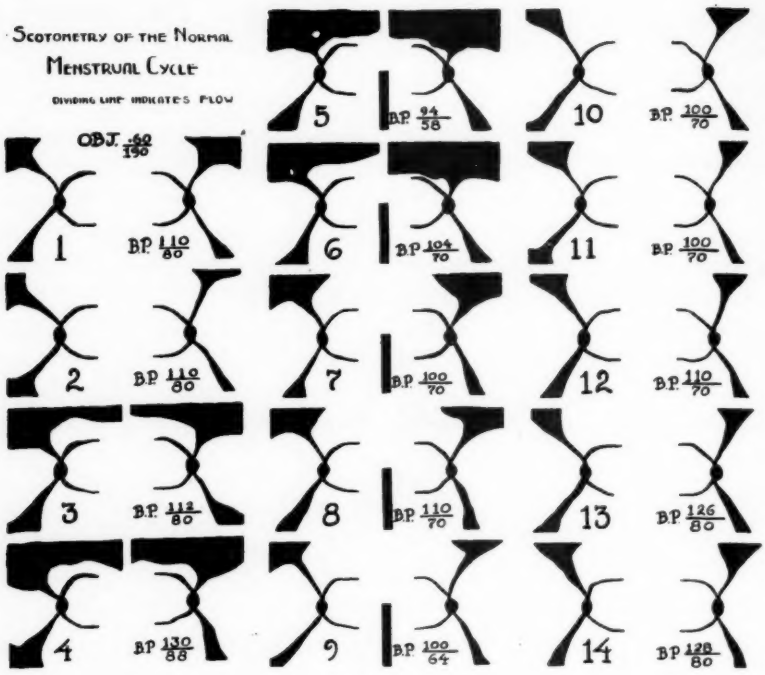
Scotometry of the Normal
Menstrual Cycle
Dividing line indicates flow
OBJ. 60/190
1 BP 110/80
2 BP 110/80
3 BP 113/80
4 BP 130/88
5 BP 94/58
6 BP 104/70
7 BP 100/70
8 BP 110/70
9 BP 100/64
10 BP 100/70
11 BP 100/70
12 BP 110/70
13 BP 126/80
14 BP 128/80

Fig. 1a.

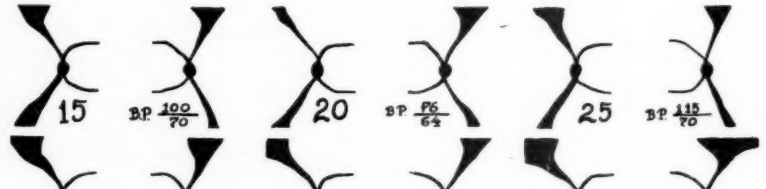
15 BP 100/70
16 BP 110/70
17 BP 110/70
18 BP 102/64
19 BP 76/64
20 BP 96/64
21 BP 114/70
22 BP 104/70
23 BP 104/70
24 BP 104/70
25 BP 115/70
26 BP 115/70
27 BP 116/70
28 BP 116/70
29 BP.——

Fig. 1b.

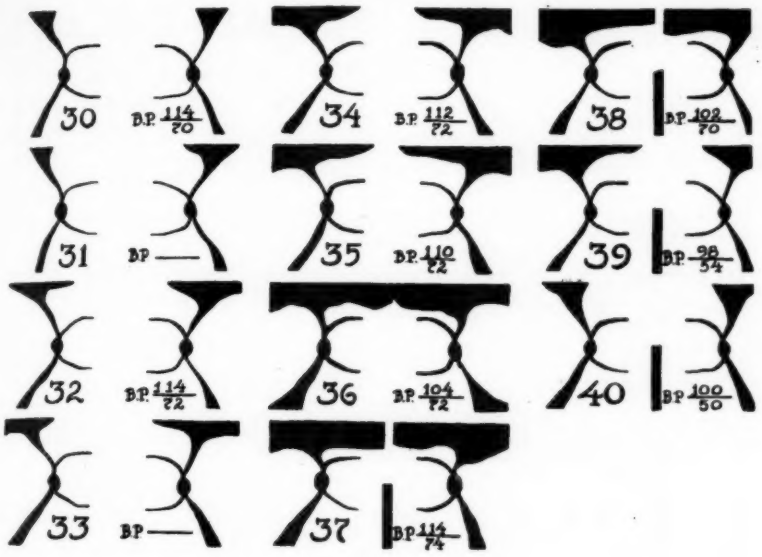

Fig. 1c.

Fig. 1a, b, c (Evans). Scotoma variations during menstruation.

scotoma were done each day through the entire menstrual and intermenstrual periods. Other attempts were made, but it was most difficult to find appropriate subjects who would coöperate regularly over so long a period. Only these five cases were followed sufficiently long to present a complete series; but other positive studies supplied reliable corroborative evidence. It would, therefore, seem justifiable to accept the charts of figure 1, a, b, c, as representing the classical scotoma variations that occur during menstruation. From this figure it will be seen that the normal defect of the superior central field begins to increase in size three days before the menstrual discharge appears, and that it clears up from three to four days before the discharge ceases. Accepting this—at least until a greater mass of evidence accumulates—as the usual relation, what change would appear with delayed or absent flow? To this end a separate study was arranged.

Group III: The material in this group is thus far represented by two cases (43 charts), as it is merely chance that provides the opportunity for this type of study. In these subjects the appearance and duration of the menstrual flow had been regular for years. In one case the study was begun three days before the usual onset of the flow, but the discharge did not appear. Figure 2a, b, presents the series of 13 maps and indicates that in this instance the flow could be—and was—predicted two days before its appearance. The findings in the second case corresponded to this; the development of the scotoma predicted the onset of the flow.

It might be assumed that the appearance of the scotoma indicated the onset of normal ovarian activity, and that the active flow as a later phase would be a constant concomitant unless the cycle were interrupted by irregularity, pregnancy, or pathological change. Obviously no such positive statement can be made until a greater mass of evidence has accrued.

If it were possible to relate variations of this scotoma to variations of ovarian activity, it is clear that an early phase of

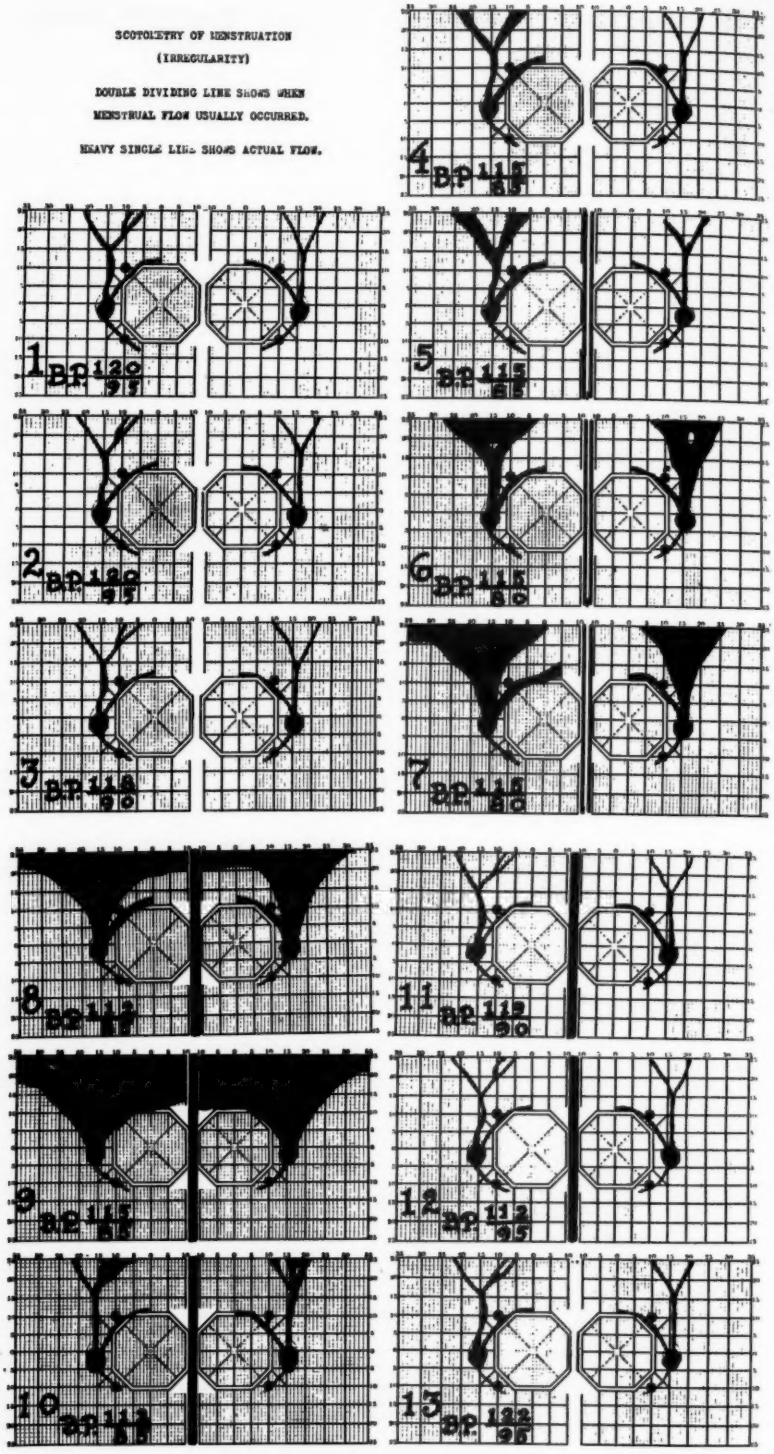

Fig. 2a (upper), b (lower) (Evans). Appearance of scotoma predicts onset of flow.

pregnancy might be recognized. To secure reliable data for such a study is quite difficult, since one must have a series of charts of a subject illustrating the individual's characteristic menstrual changes. Such a study would be made to include the entire uncomplicated pregnancy, with studies through the reappearance of the menses for one or two characteristic cycles.* It would also be necessary to be certain that the pregnancy was perfectly normal in course and termination, and a large series of such cases would have to be reviewed. Although such an ideal has as not yet been attained, it has been possible, by the study of the central field in pregnant women to secure valuable and suggestive data. The material is arranged in three groups:

TABLE 1

SCOTOMA UNITS IN SEVENTH AND EIGHTH MONTHS OF PREGNANCY. COVERING TWO PEAKS OF THE ASSUMED MENSTRUAL CYCLE

Mrs. A. Date	Day of Cycle	Blood Pressure	Scotoma Units	Vision
2/28/40	27	118/70	17	6/6+4
2/29/40	28	122/68	23	6/4−4
3/ 1/40	29	118/70	19	6/4−4
3/ 2/40	1	118/70	20	6/4−5
3/ 4/40	3	122/70	17	6/6+4
3/ 5/40	4	118/68	19	6/6+3
3/ 6/40	5	122/70	17	6/4−4
3/ 7/40	6	122/74	19	6/6+4
3/ 9/40	8	120/70	16	6/6+4
3/10/40	9	122/68	16	6/6+4
3/12/40	11	122/70	15	6/6+4
3/13/40	12	120/70	17	6/6+4
3/15/40	14	120/72	16	6/6+4
3/16/40	15	122/70	19	6/6+4
3/17/40	16	120/70	18	6/6−4
3/19/40	18	120/70	17	6/6+4
3/20/40	19	120/70	27	6/6+4
3/21/40	20	118/72	21	6/6+4
3/23/40	22	122/70	19	6/6+4
3/26/40	25	122/72	21	6/6+4
3/27/40	26	122/72	20	6/6+4
3/28/40	27	120/68	19	6/6+4
3/29/40	28	122/72	17	6/6+4
3/30/40	29	122/72	20	6/4−3
3/31/40	1	120/68	17	6/6+4
4/ 1/40	2	122/72	18	6/4−3
4/ 2/40	3	120/68	19	6/4−4
4/ 5/40	6	122/72	21	6/4−4
4/ 6/40	7	122/70	20	6/4−4
4/ 7/40	8	116/38	19	6/4−4

Variation of these scotoma units is not greater than one would expect to find during a normal intermenstruum.

Group IV: These subjects have appeared at the obstetrics clinic** for observation. It has been possible to study uncomplicated cases, and to show that the characteristic scotoma does not appear during the usual time for its appearance, were the subject not pregnant. There were

* Although one would not expect lactation to affect the scotoma, studies should be carried on through a number of cycles after lactation ceases.

** I wish to thank Dr. Alfred Beck for the privilege of studying certain cases in the Department of Obstetrics and Gynecology at the Long Island College Hospital.

six cases in this group. Patients were selected whose menstrual dates had been reasonably predictable; theoretic dates were calculated, and maps were made of the scotoma region five days before and at the height of the assumed menstruation.

Group V: Consecutive daily investigations were made during the seventh and eighth months of pregnancy. Only one pregnancy case in this group has thus far been studied. A study covering 40 days was made and included sufficient time for two menstrual cycles to pass. The lack of variation in the area of the defect is obvious by reference to the appended table (table 1) of the scotoma units. If these data were given in the form of a graph, they would be represented by an almost straight line. Occasional studies were made during the ninth month, during the calculated menstrual peaks—no defect was found.

Group 6: Only a single case has thus far been available in which the region of the scotoma of menstruation could be studied during the first 10 days of pregnancy. No scotoma was found at a time when the period was expected.

Group 7: During a study of the effects of oxygen inhalation on the angioscotoma, Dr. Charles Rosenthal[5] was fortunate in being able to include a study in which he demonstrated that the scotoma of menstruation was slightly decreased by oxygen inhalation.

Group 8: Six well-developed scotomas of menstruation were studied in order to demonstrate their identity with the angiscotoma. They show widening phenomena, the reallocation effects, and had the typical wedge shape, with base out and apex at the blind spot.

PROTOCOL

Mrs. X, aged 24 years; married two years; presented herself for ocular examination in the course of a general health examination. There were no symptoms referable to the general health or the eyes. Both physical and ocular examinations were negative.

The menstrual history was normal, except for a temporary irregularity about one year previously, which was corrected by the administration of an iron-liver preparation for a mild hypochromic anemia.

Menstruation began at the age of 14 years. The menstrual interval is from 28 to 31 days, is sometimes accompanied by mild pain, and is four to five days in duration.

At each examination care was taken to avoid such influences as might modify the conditions under which the study was made. No factors interfered with the investigation except that studies were omitted for one day, as the patient was unduly fatigued from lack of sleep. Using the technique advocated for angioscotometry, and described at length in previous communications, the normal blind spots were plotted, together with an ascending angioscotoma and one arching above the fixation point. This procedure was repeated on 23 consecutive days, and the blood pressure was recorded on each occasion. As has been stated, no studies were made on the fourteenth day.

In order to visualize the area variations of the defect, they may be set down in the form of a graph.

The area measured for scotoma units extends from above, at the edge of the chart, beginning at 25 degrees downward to the 10-degree horizontal line. This is considered as the upper extent of the normal scotoma, as based on present studies. For convenience, we measure only from the zero line, which passes vertically through the fixation point, to the 35 degree line temporally. The wheel of the map measure[4] traces the vertical lines of the chart pattern where they pass through the scotoma. The sum of these tracings is indicated on the dial of the meter, and are recorded as scotoma units (an arbitrary but convenient representation of the area of the defect). In studies of a different type other significant areas may be measured. As an illustration of graphic representation of the charts see figure 1a, b, c, and figure 3.

Relation of the scotoma variations to the various phases of the menstrual cycle

It is apparent, from the material presented in the preceding paragraphs, that there are a number of incidents in the menstrual cycle that seem to bear a time relation to the more conspicuous phases of the described scotoma. This will become more obvious as the illustrations and graphs are studied. We see that slight variations occur in the size and shape of the defect during the intermenstrual period, but that, two or three days before the appearance of the flow, an area of blindness—under the conditions of these experiments—suddenly appears and rapidly increases to a wavering plateau. Then, a day or two before the menstrual flow ceases, it rapidly diminishes to its premenstrual proportions. This is the general evolution through which the scotoma passed in each of the subjects studied.

In order to establish the classic curve for use as a standard of comparison, three of our more elaborately studied cases were selected as the most dependable of the series. The scotoma units were plotted from each day's chart for each eye separately. The corresponding figures thus collected were averaged and the results plotted, as shown in figure 3. There were 132 separate maps in this group, representing 22 consecutive days' study of each subject. The maps cover a period of 4 days before the onset of the flow and of 18 days during the flow and after it ceases. A great mass of secondary and less continuous studies, representing

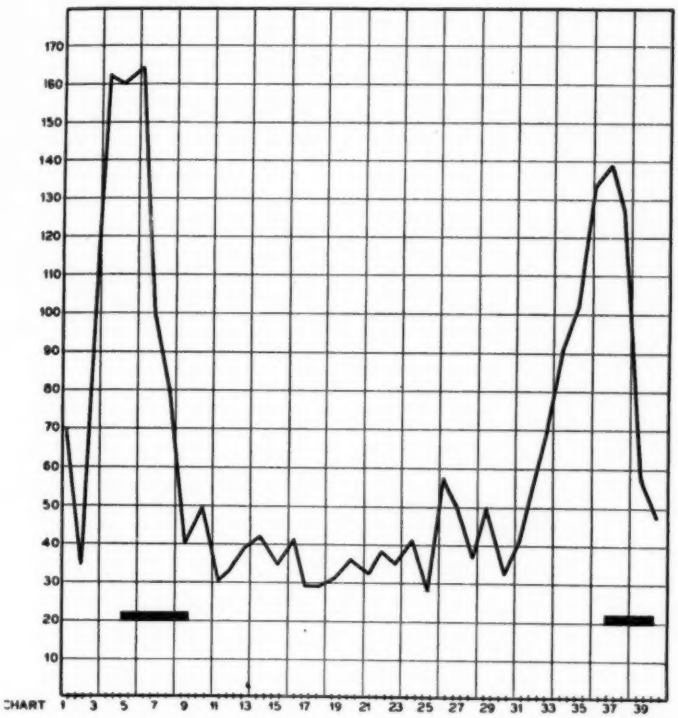

Fig. 3 (Evans). Single study covering 40 consecutive days expressed in scotoma units.

over 100 charts, supported the findings of this group; so that the appended graph seems reasonably reliable as a temporary standard. We can now compare these major fluctuations of the classical defect with the classical phases of the menstrual cycle.

Perhaps the most interesting point noted is the expansion of the scotoma two

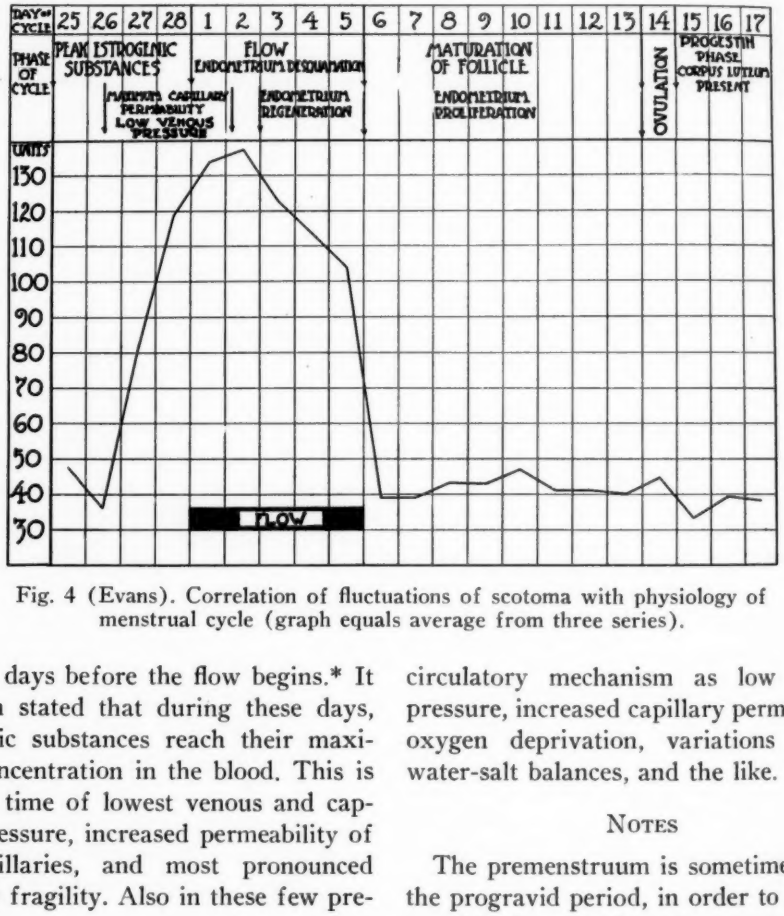

Fig. 4 (Evans). Correlation of fluctuations of scotoma with physiology of menstrual cycle (graph equals average from three series).

to three days before the flow begins.* It has been stated that during these days, estrogenic substances reach their maximum concentration in the blood. This is also the time of lowest venous and capillary pressure, increased permeability of the capillaries, and most pronounced capillary fragility. Also in these few premenstrual days vasospasm has been observed to be most marked (see figs. 3 and 4).

Elsewhere[4] evidence has been cited tending to show that similar defects in the upper visual field are due to inadequacies of the circulation of the inferior retina and that this is brought about by such disturbance of the general or local circulatory mechanism as low venous pressure, increased capillary permeability, oxygen deprivation, variations in the water-salt balances, and the like.

Notes

The premenstruum is sometimes called the progravid period, in order to impress us with the fact that the premenstruum is the climax towards which the whole cycle is directed in order to prepare the organism for pregnancy.

If there is any significance in the belief that the increased permeability of the peripheral capillaries at the premenstrual time accounts for the so-called "wet lapa-

* No attempt is made to call the reader's attention to any but the major rise in the area of the defect, for other variations have not been uniformly found. This is possibly due to the limited number of studies made daily over long periods of time. Perhaps minor scotoma variations will some day be shown to have significance.

rotomies" (excessive bleeding during laparotomy), as contrasted with the "dry laparotomies," at the intermenstrual time, then the angioscotoma should afford a quick and convenient means of recognizing this period of increased capillary permeability, and hence assist in the determination of the most suitable time for undertaking surgical procedure.

Literature

In reviewing the literature, I was unable to find any references to the defect previous to my recognition of it in 1932, or prior to my description of it in 1933.[6]

In a paper on visual-field studies in asthenopia, Dr. Beulah Cushman[7] described an enlargement of the blind spot, and of the immediately associated angioscotoma, occurring coincident with the menstrual period. She controlled her findings by studies before and after the period.

Magitot[8] and Dubois-Poulsen[9] report having satisfactorily confirmed my original studies, and the work of Dr. Charles Rosenthal has previously been referred to.

Apparently a number of studies of the peripheral-field limits have been made in the past. In 1886 and 1887 a Russian observer, L. O. Finkelstein,[10] while studying the visual fields of epileptics, observed a slight dipping of the upper limits during the menstrual period. He checked this finding on normal subjects, and found that he could confirm the results. He used 10-mm. square objects (white and colors) and a Förster perimeter of 310-mm. radius

In 1926, F. Lorenzetti[11] reported that during menstruation the visual fields had a tendency to become slightly larger in respect to the premenstrual constriction, but not so large as during the intermenstruum. He asserted that other workers do not agree with this finding. He used a 10-mm. square object on the "common perimeter." Lorenzetti included a bibliography of his work, but in some instances his data were insufficient to permit me to locate the material. Some of his references cited only Finklestein's work, or merely referred to pregnancy fields.

S. Cohn,[12] in 1890, made some peripheral-field studies on patients suffering from pathological menstruation. He used objects 15 mm. in diameter on the "Scherk" perimeter. He accepted the findings of Finkelstein, and considered that his small series of pathological cases corresponded closely to the normal.

Summary and conclusion

A scotoma apparently associated with the menstrual period has been described as present in the subjects studied, and demonstrated by the technique advocated for angioscotometry. Such a defect is wedge shaped, with its apex at the blind spot and its base located peripherally. It is one that responds to the influence of gravity, and in which transient fluctuations may be produced; as for instance by digital pressure on the eyeball. Its greatest bulk occupies the upper field, above a horizontal line 10 degrees above the fixation point. Its area and shape change with various phases of the menstrual cycle. The defect is modified by the inhalation of oxygen, and is absent during some or all stages of uncomplicated pregnancy.

For the present, it would seem reasonable to denominate this defect, "the scotoma of menstruation," to assume that it is consistently present, with no more variation than one would expect of any biological process, and that it is absent during uncomplicated pregnancy. If supplementary evidence supports the findings presented here, it seems likely that angioscotometry, properly applied and interpreted, may become an extremely useful method to aid in the diagnosis of preg-

nancy. In this case, the scotoma of menstruation would be absent two to three days before the expected flow.

Studies of the defect as modified by physiologic processes, disease, and therapeutic agents should be undertaken.

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REMOVAL OF THE LENS IN HIGH MYOPIA IN WHICH LENTICULAR OPACITIES PREVENT IMPROVEMENT OF VISION BY CORRECTING LENSES*

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Any problem connected with myopia is always worthy of consideration. The one I would offer is—"On the propriety of removing the crystalline lens in high degrees of myopia in which presenile lenticular changes, amounting to increase in the optical density, prevent improvement of the vision by correcting lenses."

By the institution, in the past 50 years, of ocular hygienic measures, and by the wearing of correcting lenses by school children from their earliest days, we rarely see today cases of the type of myopia that was once designated "malignant." Occasionally we see healthy, youthful persons whose myopia measures as much at 10 D., yet whose eyes are likely to present singularly well-preserved eyegrounds, perhaps, at most, only slight stretching of the posterior poles and narrow conuses at the disc borders. Such individuals are usually able to read without discomfort, and adapt their occupations to their visual powers.

At the beginning of the century it seemed that only cases of a different type came to our attention—those presenting extensive atrophy of the retinochoroid. Such individuals, as I recall them, were commonly of foreign birth, especially Irish and German, and were of middle age. They were usually persons of refinement, and if not especially intellectually inclined, were generally engaged in domestic occupations. They stated that they had not worn glasses in early life, but had been able to carry on, so that in recent months they had become alarmed because of failing vision.

Often it was found that the intraocular signs were deplorable, the crystalline lenses beginning to degenerate and to manifest distinct evidences of the development of cataract. The vitreous was fluid and flaky; the retinas and choroids were thin and ragged near the macular areas. These individuals found it painful, because of the distention of the globe, to focus the eyes at near points. Now and then there might have been seen, in the region of the disc, a more or less circumscribed area that seemed to have become distended beyond the curve of the scleral wall, constituting what was designated by our seniors as "posterior staphyloma." It is some years since I saw a case of so-called "posterior staphyloma" in myopia. It might be concluded, therefore, that ordinary malignant myopia *per se* has not afflicted the present generation; however, we do see cases of myopia of 10 D. or 12 D., but generally without the pathologic changes that were seen so frequently 40 years ago.

Having had the opportunity, both in private and in public practice, to attend patients continuously over a period of many years, I have observed that certain of them complained of weakness of their vision, a weakness that was not found to be dependent on alteration in the refraction-measure. Indeed, in numerous instances it was remarked that the measures had changed but little, if at all, after the twenty-fifth year. Ophthalmoscopically, one might have found thinning of the chorioretinas and diffuse sclerosis of

* Read before the seventy-sixth annual meeting of the American Ophthalmological Society, at Hot Springs, Virginia, June 3 to 5, 1940.

the crystalline lenses, the denseness, however, not having been sufficient for the case to be classed as one of incipient and advancing cataract. The vitreous might be fluid, and on rapid movement of the globe it might have shown fine filaments floating therein. I am not including in this article such grave occurrences as previous tears in the retina, with subsequent detachment of the membrane. I purpose to consider the various effects of the extraction of the crystalline lens in persons with more than 12 D. of myopia, whose visual powers can no longer be helped by spectacle lenses.

The persons here under consideration were usually active individuals, leading a more or less intellectual life, some of them having been engaged in literary pursuits. This unexplained diminution in their vision affected their whole nature, and oppressed them with the fear of total blindness. The adjustment of special telescopic lenses, because of the narrowing of the field, was out of question, and the wearing of contact glasses was not to be considered.

The lot of those afflicted with a high degree of nearsightedness is not a pleasant one, while it may happen to those past middle age that the diffraction, uncorrectable by spectacle lenses, caused by sclerosis of the crystalline lens, has blotted out all useful sight.

It has been known for a long time that in myopia aphakia greatly reduces the refraction, a fact that has inspired surgeons to suggest the deliberate removal of the crystalline lens even though it might still be transparent. An object to be attained in extracting the crystalline lens was the removal of the obscuring "screens."

In my early years the subject of myopia was regarded with cautious circumspection. My elders hesitated to undertake so drastic a procedure as the removal of a transparent lens because of the complications that had occurred at the hands of earlier operators, from whose teaching they were unwilling to depart.

The old traditional belief that myopia is a favorable condition because, at the age of 40 or thereabouts, one may not be compelled to wear glasses, as do one's farsighted relations, deterred many individuals from consulting an ophthalmologist. Those with quiet eyes rarely sought advice. "Malignant" myopia was reported frequently enough, it is true, and "staphyloma posticum" often mentioned. In such cases as these any attempt at removal of a normal lens would have been deemed rash and dangerous and condemned.

On seeing a patient whose cataract the late Dr. Norris had removed I was astonished, without any knowledge of the precedent conditions, to observe that the man was able, without the aid of a spectacle lens, to see at the highest standards. At that time I was the junior house surgeon, but I had been impressed by the almost constant necessity, in aphakia, of applying a convex sphere of about 10 D. and a cylinder anywhere up to 5 D. The records showed that before the development of the cataracts this patient had had a myopia of 12 D.

During this period of my course certain younger members of the staff attempted to remove lenses through absorption by discission, according to the method advocated by Fukala. The results which I had the opportunity to observe were varied: most of the eyes exhibited serious painful reactions, and were subjected to the effects of traumatic cataract; in more than one case the inflammatory reaction required major surgical treatment. After a year or two the procedure was abandoned. I, too, performed this operation on a schoolmaster, a graduate of a southern university, who, because of poor vision, was unable to maintain order in his classrooms. Always a student of higher mathe-

matics, he became interested in horology, and when he was forced to retire from teaching school he engaged in watchmaking and the construction of delicate registering machines. But while he was able to see clearly the tiny elements of the mechanisms in his hand, he could not, at the same time, locate his tools on the workbench. His myopia equalled 24 D. I discised the lenses by complete through-and-through incisions. The course was tedious, and at times alarming, but it was followed by good results, so that this man was able both to read and to work on his farm, to which he later returned. I have never attempted this method since.

In my mature years, while in active service at Wills Hospital, I have deliberately extracted the lens by a procedure and technique exactly like that which would have been employed in advancing cataract. Perhaps as many as three patients a year were treated by this method —in all, about 50. The members of my staff repeatedly suggested that I should report my experience. The leisure in which to collect the cases has not permitted me to do this, but I will report them in a general way. All the patients were selected with great care; their general health, as well as the history of the course of the myopia and the state of the fundus, was especially noted. They were all myopic to a degree not below 12 D.

Several private patients have come to me voluntarily, since the last meeting of the society, desiring to have their cases reviewed, or perhaps to inquire as to the feasibility of changing the style of the spectacles they have been wearing. All had been treated three or more years previously, and none had lost ground during the past year or so.

Case 1. J., aged about 50 years, was a Russian Jewess, a member of a rabbinical family. She had always been near-sighted, and for several years was unable to carry on. In recent months she depended on her near vision without the aid of spectacles.

There was myopia of about 20 D. The lens of the right eye was sclerotic in the nasal portions; the nucleus of the left lens was quite dense; the retinochoroid was atrophic in maplike areas. In 1922, the lens of the left eye was extracted and a capsulotomy was performed a few months later. The patient was not seen again until January, 1929. She had regarded herself as blind because no spectacles had been worn. There was a mature cataract in the right eye.

The capsule of the lens of the left eye was adherent to the colobomatous iris; There was no evidence of traumatic inflammation. The appearance of the fundus was recorded for the first time. There was extensive atrophy and thinning of the retinochoroid, and the vitreous was fluid and flaky.

In February, 1929, the lens of the right eye was extracted with forceps. Healing was prompt, and the patient left the hospital on the seventh day.

In March the following glasses were ordered: R.E. -2.25 D.sph. $\bigcirc\!\!\!\!\bigcirc$ $+1.75$ D.cyl. ax. 180°; L.E. -1.75 D.sph. $\bigcirc\!\!\!\!\bigcirc$ $+1$ D.cyl. ax. 180°.

A short time after this a small cyst was discovered in the right eye, circumscribed far forward in the lower nasal quadrant. The retinochoroid was widely atrophic, yet not so extensively as in the left eye. In 1930 vision was: R.E. with $+3.00$ D.cyl. ax. 180° $= 4/20$; L.E. with $+1.50$ D.cyl. ax. 180° $= 4/30$. The addition of $+4$ in bifocal segments enabled her to read again. Great patches of sclera spanned by blood vessels glistened in the atrophic areas. Fortuntely the maculas were not eroded. The patient was not seen again until 1935. At this time the cyst was larger, but was still sharply circum-

scribed and immobile. There was no sign of detachment of the preserved portions of the retina. This condition has remained ever since. The patient has been able to live an entirely independent life, manages her own household, reads and sews, enjoys the theater and movies, but refuses to consider operation on the cyst, fearing the loss of vision in her right eye. The refraction measurements have changed somewhat, the last record in 1936 being: R.E. −3 D.sph. ⌯ +1.25 D.cyl. ax. 180° = 4/12; L.E. −4 D.sph. ⌯ +3.25 D.cyl. ax. 180° = 5/15.

Case 2. In May, 1914, M. C., aged 50 years or older, the companion of an aged invalid, consulted me because her vision had become so much reduced that she was unable to read comfortably. She "had been nearsighted all her days, but had worn glasses for 16 years only; Those usually purchased were 'number 20.'" She preferred to use no glasses for near-at-hand occupations. The formulas of the latest were, approximately, −15 D.sph. ⌯ −2 D. cylinder.

Without glasses vision = 1/50; with glasses, 5/30 : 5/25. Opacities floated in the vitreous; the fundi were extraordinarily well preserved for a myopia of 24 D.

After a year's observation, the vision continuing to fail and the muscae becoming increasingly annoying, I suggested the extraction of the lenses as a means of improving her sight. She removed from the city, and I did not see her again until 1921, when the ocular conditions were practically unchanged. In 1936, the patient's funds having become exhausted, she could not obtain employment because of her blindness.

In January, 1937, the lens of the left eye was extracted; in February, the lens of the right eye was removed by the combined method. Healing was prompt, and the patient was discharged from the hospital in 10 days. The capsular remains in each eye were subsequently needled.

In May, 1937, vision R.E.: +2.25 D.cyl. ax. 180° = 5/25; L.E.: +2.75 D.cyl. ax. 180° = 5/12.

In March, 1940, vision R.E.: −1 D.sph. ⌯ +2.50 D.cyl. ax. 180° = 5/15; L.E.: −1 D.sph. ⌯ +2.75 D.cyl. ax. 180° = 5/12; with +3.75 added, she read easily.

The vitreous has cleared, and the fundus can now be studied, which was not possible before. Besides attenuation of the retinochoroids, there is a narrow absorption conus at the nasal border of each disc.

Case 3. P. S., a literary lady, aged 71 years, was nearsighted from early girlhood, and never was able to attain the highest visual standards desired by several ophthalmologists. In the 18 months prior to consulting me she found, to her anxiety and distress, that her vision had become so greatly reduced that she could no longer read with comfort. She had been wearing: R.E.: −14.00; L.E.: −15.00, with which she obtained only 4/35 and 2/45.

The lenses were sclerosed, with faint riders in the peripheral zones; no gross changes were visible in the fundi, which were remarkably preserved for a myopia of approximately 20 D. Vision R.E.: −12 D.sph. ⌯ −2.0 D.cyl. ax. 15° = 4/22; L.E.: −10 = 4/25. The correction gave but little relief. Extraction of lenses was recommended. Operation was deferred until the autumn.

In October, 1935, combined extraction of the lens of the left eye was done. Healing was prompt. Some opaque cortical substance caught in the folds of the capsule. The patient returned to her home on the ninth day. Absorption of the retained cortical material was sluggish; needling five weeks later. In January following, vision L.E.: +2 D.sph. ⌯ +2.50

D.cyl. ax. 180° = 4/9. Extraction of the lens of the right eye was urged, but I hesitated because of the fluid vitreous. Combined extraction was performed without accident. The patient returned home on the tenth day. Capsulotomy was necessary, for the lens capsule obscured the pupillary space. Four weeks later, vision R.E.: +1 D.sph. ⊂⊃ +1.75 D.cyl. ax. 165° = 5/7; and, +4 added, made easy reading possible. Two years later, vision R.E.: +1 D.sph. ⊂⊃ +2.75 D.cyl. ax. 180° = 5/7; L.E. +1.62 D.sph. ⊂⊃ +2.0 D.cyl. ax. 10° = 5/5; + 3.50, additional comfortable reading glass.

In November, 1937, while riding in a trolley car, she suffered a stroke, distorting her face and leaving the left side paretic. In January, 1938, she was able to go for walks and resume her visits to lectures, concerts, and the theater. After a few weeks, however, locomotion became difficult, and in recent weeks she had not left her house. The last visit to me in December, 1939, showed: vision with +2 D.sph. ⊂⊃ +2.50 D.cyl. ax. 165° = 4/6; +2 D.sph. ⊂⊃ +2 D.cyl. ax. 180° = 5/6. Vitreous of each eye was decidedly fluid, but no vascular changes were present.

Case 4. M. R., an executive civilian-clerk in the United States Navy, aged about 50 years, had been nearsighted since her earliest days. She came because of failing vision, and because, for the first time, she had headaches and was asthenopic. She feared dismissal, and was additionally distressed because her last consultant told her that she was likely to have cataracts, eventually necessitating extraction, of which she had great dread.

She was a small, shrinking creature, who, on attempting to read, held her office record-cards as close as the length of her hand. Vision R.E.: less than 1/60; L.E. also less than 1/60; with her glasses, R.E. 1/50; L.E. 1/45.

The anterior segments were healthy; the lenses sclerosed, without distinct opacities, yet no clear views of the fundus were obtainable because of the diffraction.

She had been under the care of distinguished ophthalmologists in Philadelphia, all of whom are now deceased. It was learned from the records of the last examination, made in 1920, that: R.E. −15.00 D.sph. ⊂⊃ −2 D.cyl. ax 105°; L.E. −11 D.sph. ⊂⊃ −1 D.cyl. ax. 105° had been ordered, and that except for a narrow band of absorption about the disc, the fundi were well preserved considering the degree of myopia that existed.

After much persuasion the right eye was submitted to operation. In July, 1936, the lens was extracted, and on the tenth day she left the hospital. Capsulotomy was performed one month later. On August 20: vision R.E. +2 D.sph. ⊂⊃ +2.25 D.cyl. ax. 165° = 5/12. Singularly, at the end of the month, without a glass, vision = 5/12, and with +4 D.sph. she read J 1 at 20 cm.

In February, 1937, combined extraction of the lens of the left eye was done, leaving some cortical matter. The patient left the hospital after 10 days. Four weeks later, vision L.E. +1 D.sph. ⊂⊃ +2.25 D.cyl. ax. 180° = 4/12.

The patient resumed her work. The last formulas were: vision R.E. +2.50 D.cyl. ax. 180°; L.E. +1 D.sph. ⊂⊃ +2.0 D.cyl. ax. 180° = 5/15. It is possible for her to read and work with the same glass.

Case 5. F. C., a highly cultured woman, aged about 68 years, of North American Indian ancestry, had never been able to see at a distance as well as her sisters did, and for the past five or six years she had had practically no vision in the right eye. She had given up music and the theater, but could write without much discomfort. She manifested the self-confidence and self-assurance of the confirmed myopic

person, and stated that usually she made her own selection of lenses, which measured about "number 10"; all were curved so deeply, however, that the borders had to be ground. She remembered that in her childhood her eyes were not so straight as were her sisters', and that some operation had been done to straighten them.

The lens of the right eye was so cataractous as to prevent all but peripheral views of the fundus. The lens of the left eye was sclerosed; the fundus, quite healthy. Vision, R.E. −12.00 D.sph. = 5/9; no glass was helpful for reading.

The lens of the right eye was to be extracted after a preliminary iridectomy in March, 1938. Recovery was prompt; patient left the hospital in two days. Two months later the lens was extracted, and she left the hospital in eight days. After two weeks, vision, R.E. +4.50 D.sph. ⊂⊃ −3.0 D.cyl. ax. 30° = 5/75.

On August 7th the lens of the left eye was extracted; recovery was prompt.

The retinas were unusually healthy. Formulas in April, 1939, were: R.E. +5.50 D.sph. ⊂⊃ +2.25 D.cyl. ax. 30° = 5/5; L.E. +4.25 D.sph. ⊂⊃ +2.25 D.cyl. ax. 150° = 5/10.

The patient carries on her former occupation, reading and reviewing works of fiction. After eight years she is again able to play duets at the piano with her sister.

The following is the only one of this group in whom extensive degeneration of the retinochoroid had taken place, as in the old-time "malignant" myopia. The patient was not selected; his case was undertaken at his urgent request, and at that of his family and friends, "who had some knowledge of the possibility of increasing the powers of the nearsighted by an operation like that for cataract."

Case 6. G. G., in 1932, was aged about 45 years. He stated that he had been nearsighted all his days, and had been wearing −16 D. spheres; that he had been unable to see for a year or so prior to consulting me. Formerly engaged in a fine mechanical trade, he had been out of employment for a time.

Visual acuteness in each eye was only 1/80 with his glasses, and he could read only the largest headlines of newspapers.

Globes were not prominent; crystalline lenses, when fully exposed, were diffusely sclerosed, but without clumped or streaked opacities. The vitreous was fluid; the retinochoroids were thin and atrophic. No lenses that could be prescribed increased his vision.

The lens of the left eye was extracted without accident, the hyaloid membrane firmly resisting. The wound of incision united promptly. Moderate reaction persisted for several weeks, after which it was possible for the patient to go about, seeing with his left eye, but without the aid of glasses. The sclerosis of the lens of the right eye increased, and refraction could not be determined. He was not seen again until January, 1936, when he returned because of inability to see as well as he could after operation. Thickened capsule obscured the pupillary space. Capsulotomy was performed and afforded a clear view of the fundus.

In February: Vision, −1.50 D.sph. ⊂⊃ −2.75 D.cyl. ax. 180° = 2/30; no cylinder was prescribed, as he preferred vision obtained by the sphere alone. A few months later he reported "seeing more and more but annoyed by the doubling of lights at night."

In the succeeding 18 months he depended solely on his left eye; he frequently went on ocean fishing trips. In July, 1939, the right eye was no longer useful; the left eye enabled him to lead an independent life and to read newspapers. But by February of the present year, because of degeneration of the vitreous, fundus details could not be defined. The patient does not regard himself as

"blind," as he still can go on his fishing trips.

The modifications in the long-accepted technique of cataract extraction that have been perfected in recent years have amply demonstrated that the myopic eye can withstand incision and other manipulations such as it was not believed years ago that the eye could endure safely. In none of the eyes described in this group was there any escape of vitreous, and in none was there subsequent hemorrhage.

This article is offered to show what surgery has done to restore to active existence several persons who might otherwise have been committed to a life of idleness.

317 South Fifteenth Street.

Discussion

Dr. Allen Greenwood, Boston, Massachusetts: My experience with such cases up to within a few years has not been very encouraging. I found that when I performed a combined extraction, I was certain to have a good deal of cortex left, and that I would have to do a discission, and the results were not good. I was loath to attempt extraction in the capsule in patients with high myopia, but finally concluded that the zonule in high myopia must be feeble, and that extraction in the capsule might be promising. Since then I have had exceptionally good results from extracting the lens in the capsule; there were no bad aftereffects, and the patient's vision was excellent. In one of my cases, a woman in middle life, I prescribed a −32 D.sph. for constant wear, and with a −6 D.sph. over it she had useful vision for the theater and the like. Measured with a concave mirror retinoscope, she had from 35 to 38 D. of myopia. She had lost the left eye, and the right one developed a cloudy lens; her vision was reduced so much that she had to be led about. I extracted the lens in the capsule, without the least loss of vitreous, and I believe that she is one of the most grateful patients I have ever had. She can see well without a glass, although she is a little better with a minus lens. This is the only case in which I have ever had to give a minus glass after operation; and with the combination of a minus lens and a plus cylinder she can read Jaeger 2. I have had a number of cases with a myopia of over 20 D. in which I have removed the lens with the capsule, and I do not believe we need to hesitate to remove the lens in the capsule in cases of high myopia. In none of these patients has there been any loss of vitreous. In the case with the myopia of 38 D. the lens was extracted almost entirely by traction with the capsule forceps, with almost no pressure below. I recommend that, instead of doing a combined extraction and cutting the capsule, you extract the lens in the capsule in high myopia. I believe that your results will be excellent.

Dr. F. H. Verhoeff, Boston, Massachusetts: I agree completely with Dr. Chance in his view that the lens should be removed in such cases, and I agree with Dr. Greenwood's views about intracapsular extraction. I have been doing the intracapsular extraction in such cases for many years. A number of the patients have prominent eyes, so that, according to the current views, loss of vitreous must be feared, but this has not deterred me, and I have had less loss of vitreous than in the usual run of cases. There are certain other points that I have learned that have not been mentioned. I have observed that these patients do not obtain good vision until an unusually long time after operation. At the end of six weeks vision may be only 20/100, and yet six months

later it may be 20/40 or better. I do not know why this is. I presume that there is an edema of the macula which interferes with vision and which takes some time to disappear. I have also found that these patients have much more astigmatism than do others. Some have 4 or 6 D. At first I feared that separation of the retina might occur afterward, but this has not been my experience. I believe that Dr. Haskett Derby once said that if there is marked myopic chorioretinitis, separation of the retina will not occur in cases of high myopia. I know that this is not strictly so, but I believe there is a great deal of truth in the statement.

The paper does not deal with the question of the young myopic persons who have clear lenses. I have removed the lenses by discission, followed by linear extraction, in several such cases, with good results, but it seems to me that if we can obtain reasonably good vision with glasses, it is a little safer not to perform the operation.

As Dr. Greenwood says, these patients are the most grateful ones that we have. After the operation they often see better than they have ever seen, and they are much impressed by the fact that they can see well without the aid of glasses. I tell such patients that they are very lucky to have a cataract, for otherwise I might not have felt like operating on them.

DR. BURTON CHANCE, closing: I wish to thank Dr. Verhoeff for agreeing with me. I read in abstract the histories of but two of the cases included in my report. In all there may be found some of the details on which he commented; namely, the later visual improvement, and the fact that I deemed it unnecessary to extract the lenses in their capsules. In one instance I did a true extraction, and brought the lens out with the forceps. In none was there escape of vitreous, nor has there been a subsequent detachment of the retina. In one case a cyst of the retina, far down in the nasal quadrant, has developed. This has remained exactly as when I first saw it. The patient refuses operation, as she has fairly good vision.

EXOPHTHALMOS IN HYPERTHYROIDISM

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The problem of exophthalmos resulting from toxic goiter is a vexing one for the ophthalmologist. Not only is the mechanism of its formation unknown, but its pathology is in dispute, and, what is even worse, treatment to prevent the disastrous sequelae is usually fruitless. Apparently the underlying physiological and pathological factors vary in the different cases and only by understanding these factors can we hope to prevent the sometimes terrible consequences.

Any experiences with such cases are therefore well worth reporting, in the hope that from the sum total of experiences a rational method of therapeutics may be evolved.

In 1858, Müller[1] discovered two sets of smooth muscles in the orbit of mammals, a periorbital and a palpebral set. In lower animals the periorbital muscle is well developed and consists of a muscular cone the base of which is attached to the orbital septum and bony ridge of the orbit; the apex is attached to the ligament of Zinn, thus enveloping the entire contents of the orbit except the lacrimal sac. This is a powerful muscle and when electrically stimulated is capable of pushing the orbital contents forward, overcoming the normal antagonism of the recti and the retractor bulbi muscles.

In 1904, McCullum and Cornell[2] removed the roof of the orbit in a dog and, by stimulating the cervical sympathetics, observed typical smooth-muscle contraction waves. Cutting the cervical sympathetic on one side caused a marked Horner's syndrome, consisting of ptosis, enophthalmos, and a small pupil.

In the lower animals, the palpebral muscle has been demonstrated in the lower lids only. According to Hesser,[3] this muscle is derived from the striated recti muscles.

In man and the anthropoids, the periorbital muscle is vestigial, and is usually considered to have no influence on the position of the orbital contents. Nevertheless, cutting the cervical sympathetics results in the appearance of Horner's syndrome (enophthalmos, slight ptosis, and a small pupil) although not so marked as in the lower animals. The palpebral muscle is present in both the upper and lower lids in man and the anthropoids.

According to Marine,[4] stimulation of the cervical sympathetics causes lid lag (Von Graefe sign) and a widened palpebral fissure (Stellwag's and Dalyrimple's signs) but he believes that, in man, stimulation of the periorbital muscle in itself is not a sufficient cause of exophthalmos, and that additional factors must be sought.

Russell[5] showed the presence of smooth-muscle fibers in the orbit of man similar in situation to Müller's orbital muscle in the lower animals. He demonstrated the presence of the periorbital muscle as a cone-shaped glistening membrane closely enveloping the soft tissue of the orbit. In six cases of Graves's disease examined by Brunton,[6] these fibers were demonstrated by him, and, in the opinion of the authors, these fibers when stimulated are sufficient to produce exophthalmos.

On the other hand, Rhea[7] states that in the dissection of many orbits, he could never define a Müller's muscle. He did, however, demonstrate many smooth-muscle fibers in Tenon's capsule which were innervated by sympathetic nerves from the cavernous plexus via the ciliary ganglion and the long ciliary nerves. In

Starling's[8] opinion, stimulation of the sympathetic nerves causes contraction of these muscles, resulting in protusion of the eyes and rise of intraocular pressure.

Clinical justification for such an assumption is furnished by a case reported by Magitôt.[9] In a case of iridocyclitis, in which a few drops of adrenalin were injected subconjunctivally in order to induce mydriasis, 10 minutes sufficed for the development of mydriasis, but there were also widening of the palpebral fissure, retraction of the upper lid, and a moderate degree of exophthalmos. Magitôt considered this to be the result of a hypersensitivity to sympathetic stimulation.

Labbé[10] and his co-workers as the result of both clinical and considerable experimental observation believe that the absence of mydriasis in hyperthyroidism proves that sympathetic excitation is not a cause of exophthalmos, for stimulation of the cervical sympathetics always results in mydriasis rather than in exophthalmos.

They recite the case of a myxedematous woman who was receiving thyroxine. Her metabolism was greatly increased and her general condition improved. There was no exophthalmos. Ephedrine, 0.05 gr., was injected intravenously, and in 10 minutes bilateral exophthalmos, more marked in the left eye, was produced. Both pupils were dilated. The same experiment was repeated a week later with the same results.

In another case of exophthalmic goiter the intramuscular injection of 5 mg. of yohimbine, followed the next day by an injection of 0.1 gram, resulted in the regression of the exophthalmos.

These facts in addition to the results of experiments with animals led them to believe that exophthalmos is the result of a mixed stimulation of both the sympathetic and the parasympathetic systems.

The present consensus of opinion is that factors other than stimulation of Müller's muscle is a cause of the exophthalmos, or that factors in addition to stimulation of Müller's muscle cause the marked exophthalmos of hyperthyroidism.

Basedow[11] considered exophthalmos to be the result of an hypertrophy of the cellular tissues in the orbit, while Sattler[12] and W. Krauss[13] held that a venous congestion was the underlying cause.

In 1898, Ashkenazy[14] demonstrated the presence of a fatty degeneration of the recti muscles in cases of hyperthyroidism. Naffziger[15] showed the enormous size these muscles may attain as a result of a chronic inflammatory infiltration. These have since been found by many observers, particularly in cases of increasing exophthalmos following thyroidectomy. In two cases presenting such muscular changes, Reese[16] demonstrated that the lacrimal glands had lesions similar to those found in the muscle tissue. The glandular tissue was in all stages of degeneration and was being replaced by edematous fibrous tissue, throughout which were numerous lymphocytes.

Smelser[17] believes that, in exophthalmos, the orbital tissues are modified by edema and cellular infiltration, and that these factors may be responsible for the persistence of the exophthalmos following thyroidectomy. He presents the biopsy reports of the orbital tissue in six cases of exophthalmos. The connective tissues were edematous, and there was cellular infiltration differing in amount. In several instances aggregations of these cells were found in rounded masses, frequently perivascular.

In experimental animals in which exophthalmos was induced, the average total weight of the orbital contents was 34 percent greater than in control animals—sufficient, in a confined space, to cause exophthalmos. Similar findings were present in sympathectomized ani-

mals. In Smelser's opinion the anatomy of the orbit seems to preclude a severe exophthalmos due to sympathetic stimulation. Injection of sodium iodide did not prevent the occurrence of exophthalmos, but thyroxine had a marked effect in decreasing the total quantity of orbital tissue.

Merrill and Oaks[18] reported two cases of extreme bilateral exophthalmos with complete loss of vision. They expressed regret that none of the ophthalmologists they had written to were able to give them any practical help. Both patients had had early thyroidectomies without receiving any beneficial effect on the exophthalmos. The authors claimed that a thorough search of the literature revealed the fact that thyroid surgery had no beneficial effect in arresting the progress of the exophthalmos and consequent destruction of the eye. Cervical sympathectomy was not attempted because they believed that the extreme proptosis could not be accounted for by stimulation of the cervical sympathetics.

In one of the cases, an eye was enucleated, and the authors observed that the operation was practically bloodless. This, they felt, was contrary to the theory of venous congestion as a cause for the exophthalmos.

The second patient died at the height of the exophthalmos and conjunctival edema. It was noticed that soon after death the conjunctiva ceased to protrude. This, in the opinion of the writers, did not bear out the theories that this condition was the result of a hyperplasia of tissue or an increase in the orbital fat.

In the last few years, new factors to complicate an already extremely complicated picture were introduced by Marine and others working with ductless glands.

In 1910 Gley[19] reported the development of exophthalmos in male puberal rabbits following thyroidectomy. In 1931, Schokaert,[20] working with baby ducks, and Loeb and Friedman,[20a] using young guinea pigs, produced exophthalmos by giving 7 to 10 daily injections of anterior-pituitary extracts.

In 1932 Marine[4b] and his co-workers developed parenchymatous goiter with exophthalmos in puberal rabbits on a diet of alfalfa hay and oats, and with daily intramuscular injections of 0.1 c.c. or more of methyl cyanide.

The goiter was the first to appear, and this was followed shortly by the exophthalmos. Associated with these was an hypertrophy of the anterior pituitary gland. When the thyroid glands were removed, prior to the institution of the alfalfa diet and cyanide injections, exophthalmos was more easily and more quickly induced. Likewise, in guinea pigs, exophthalmos was more easily induced with anterior pituitary injections, if the thyroids were first removed. In fact Friedgood[21] found that the most pronounced exophthalmos was more easily induced in guinea pigs after the metabolic rates had fallen below normal; and Rogowitch[21a] showed that thyroidectomy was the most potent physiologic stimulus to the anterior pituitary gland.

Marine and his co-workers, therefore, concluded that the thyroid hormone took no part in the production of the exophthalmos, but that some substance of the anterior pituitary gland was responsible via a direct or indirect stimulation of the sympathetic nervous system.

These observations are in line with the opinions of many clinicians that exophthalmos is more apt to result from subactive thyroids or after partial thyroidectomy (Merrill and Oaks, Labbé *et al.*, Smelser).

It is well known that the administration of thyroxine or desiccated thyroid cannot produce exophthalmos in either animal or man. In fact, thyroxine offers

specific protection against the production of exophthalmos in rabbits and guinea pigs, and the administration of thyroxine cured the exophthalmos produced by Marine and his co-workers. Iodine, in the presence of abundant thyroid tissue, had the same effect in preventing exophthalmos in the guinea pigs and rabbits, as when desiccated thyroid was fed, and according to Plummer and Wilder[22] the present widespread use of iodine in the presence of hyperthyroidism has greatly reduced the incidence of exophthalmos.

In spite of the fact that exophthalmos may occur when the thyroid is subactive, yet it does not occur in instances of cretinism or myxedema, so that other etiologic factors are necessary.

It had long been noted that exophthalmos was much more common in males, even among experimental animals, and that in these animals the greatest degree of exophthalmos was produced in the most sexually active.

Marine and his co-workers subsequently found that no frank exophthalmos developed in any of the 38 adult male and 23 adult female rabbits after gonadectomy. They also found that gonadectomy resulted in the regression of the exophthalmos in nine male rabbits within 3 to 5 weeks, but was unchanged in the controls. Further investigation led them to conclude that the germinal epithelium had nothing to do with the development of the exophthalmos, but that the activity of the interstitial cells was the deciding factor. The absence of exophthalmos in cretinism and myxedema may be the result of a relative absence or inactivity of these cells.

From all this they conclude that exophthalmos appears to be due to the action of an excess of anterior pituitary, directly or indirectly, through the gonads on the sympathetic center in the hypothalamus. A prime requisite is a deficient amount of thyroxine in the thyroid gland.

An additional factor seems to be the large amounts of calcium and phosphorus which are excreted in cases of hyperthyroidism. This results in increased irritability of the nerves.

In the opinion of Marine and his co-workers, early sympathectomy, at a time when indications are not yet definite, would do away with the exophthalmos. In animals, cervical sympathectomy completely does away with the exophthalmos. They feel that all available facts prove that the mechanism causing exophthalmos works through the nervous system.

It was in 1857 that Lorenz first recorded the necessity of enucleating both eyes because of extreme proptosis and corneal destruction. Such a malignant type of exophthalmos was first brought to our attention by a dramatic experience.

In the fall of 1938, one of us (D. K.) was asked to see a patient in a penal institution. A boy, aged 23 years, had already been in prison for six years for participating in a hold-up. He was difficult to handle and was transferred from institution to institution, finally landing in one to which the most difficult cases were sent. Even here he proved difficult, and spent a good deal of time in solitary confinement as well as undergoing other forms of punishment. About two months prior to the author's visit, he developed a considerable exophthalmos of both eyes and shortly afterward a thyroidectomy was performed. It was not clear to the writer whether the corneae were involved previous to the thyroidectomy, but about two weeks following this operation, the parents received a letter asking authorization for bilateral enucleation. The author found a young man with a bilateral edema of the conjunctiva protruding like two red mountains (at least two inches). No corneae were visible, but in the center

of these mounds were two craters in which no ocular structures were visible —as if the eye had melted away. It was a most gruesome spectacle.

The next year, one of us (D. K.) had the opportunity of watching the progress of another such case from its inception—so that the sequence of events was followed.

This was the case of a colored man, aged 46 years, who was referred by his family doctor to the Brooklyn Hospital on August 7, 1939, with a history that for about the past three months he had been irritable, nervous, and had lost weight, although the appetite was good. He complained of redness of the eyes, some difficulty in vision, and moderate exophthalmos of the right eye. Three months prior to admission a Wassermann test was reported as 1 plus, and X-ray studies of the chest revealed a substernal thyroid gland.

The hospital admission note read as follows: 1. Both lids, especially the upper of the right eye, are edematous. 2. There is a grayish area in the lower part of the cornea of the right eye. 3. The heart is enlarged. The sounds are hyperactive and rapid. There is a dullness in the first interspace, 3-4 cm. to each side of the heart. 4. The extremities are warm and moist and there are fine tremors of the hand. The patient looks very emaciated. *Impression:* (1) substernal thyroid; (2) exophthalmos; (3) mitral insufficiency and moderate hypertension, 170/80.

X-ray examination of the chest on the same day showed no evidence of a substernal thyroid and one taken the next day showed no evidence of orbital tumor or bony obstruction.

On August 9, 1939, the patient was examined by Dr. Walter Moore, who noted that the right eye was intensely injected, with dilatation of the pupil. Tension by palpation was slightly elevated although the eye was not hard. There was an ulcer of the cornea just below the pupillary border. The left eye showed only a slight conjunctivitis. A basal-metabolism reading was recorded as plus 67.

The following day it was observed that the chemosis of the conjunctiva was considerably worse. The proptosis had increased and the tension to fingers was 4 plus. Because of the summer schedule, the patient was subsequently followed by one of the writers (D. K.) who made the following note on August 11, 1939:

The right eye could not be closed, so that the lower part of the cornea was constantly exposed. The lids were very tightly applied to the eyeball, and in the palpebral area there was considerable chemotic conjunctiva. The tension to fingers was increased. The cornea was edematous so that the fundus was not visible. There was a large, dirty ulcer in the lower part of the cornea. Vision was the ability to see fingers at one foot. The left eye was entirely normal.

The ulcer was cauterized with tincture of iodine. An external canthotomy, to relieve pressure on the eyeball, was performed, and a thick layer of sterile vaseline was placed over the eye. Over this vaseline gauze was bandaged in place. The next day the ulcer appeared cleaner but the ocular tension remained high. The same treatment was repeated daily until August 15th, when on removing the bandage the ulcer was found to have ruptured and lens material was found in the wound.

During all this time the left eye remained in normal condition. However, the next day, August 16th, the patient developed a lagophthalmos of the left eye, so that the eye could not be closed completely, and a small infiltration of the cornea near the lower limbus was observed. The question of thyroidectomy again came up, and the surgeon then in charge thought it inadvisable to operate.

The patient was very emaciated, and his general condition was quite poor.

However, in view of the danger to his only remaining eye, we felt that more drastic therapy besides the local treatment was indicated, and 10 c.c. of milk was injected intramuscularly. The ulcer was cauterized and an external canthotomy was performed. This was done more as a preventive measure, because conjunctival edema was not yet present. Sterile vaseline was applied, bandaged in place with sterile vaseline gauze. The patient stood the milk injection well and reacted with a temperature of 101°F. The next day there was considerable conjunctival edema, the cornea was hazy, the tension of the eye was elevated to 2 plus, digitally. The ulcer had spread considerably, and there was an undermined edge around its entire circumference.

At this time the patient was visited by Dr. Charles H. Hargitt who advised the use of sulfanilamide, with the approval of the medical department, which also considered the patient to be a good operative risk. Ten grains of prontylin was given every four hours. The ulcer improved in appearance, and we thought the situation was well in hand. However, on August 26th, the ulcer began to increase in extent, and 10 c.c. of milk was injected, resulting in a rise of temperature to 102°F., but the hypopyon and the ulcer increased in extent. In view of the desperate situation and in spite of his physical condition, 20 million typhoid bacilli were injected intravenously. The patient reacted fairly well to the injection and had a moderate reaction of 101°F. This was repeated the next day, but four days later the eye became worse. On September 7th, 30 million typhoid bacilli were injected intravenously. This resulted in a temperature of 104°F., and it was repeated the next day. On the following day the ulcer of the left eye ruptured.

On September 12th, almost all of the thyroid gland, excepting a small piece on the left side, was removed. The patient stood the operation well, but on September 14th, he developed auricular fibrillation, which disappeared in a few days.

Following the operation he began to gain weight, and had an uneventful convalescence. On October 10, 1939, a basal metabolism reading was plus 12. The right eye still showed considerable conjunctival edema, but light perception and light localization were present. In the left eye the lagophthalmos had disappeared, so that he was able to close the eye without difficulty, but chronic edema of the conjunctiva was present (fig. 1).

A biopsy of a piece of conjunctiva, taken September 7th, was examined by Dr. De Veer and was reported as acutely inflamed conjunctival tissue.

Pathologic section of the removed goiter was reported as diffuse goiter with involutional changes probably due to iodine therapy.

The patient was discharged from the Brooklyn Hospital and came under the writer's care at the Brooklyn Eye and Ear Hospital. Because of the unsightly right eye, which was quite proptosed and degenerated, enucleation was performed. The left eye, which he still can close normally, was retained. Light localization is still present in that eye.

Features of the enucleation were that there was no excessive bleeding, and that no excessive amount of orbital tissue was found (fig. 2). The ocular muscles were thin and atrophic. The socket appeared no different from that of one from which the eye was removed for an iridocyclitis, and an artificial eye presents an entirely normal appearance.

Section of the eye revealed no pathology of specific bearing on the subject.

A third case was under the care of one of us (W. M.) at the Kings County Hos-

pital. S. L., a female, aged 55 years, was admitted on January 25, 1940, with a complaint of pain in the right eye. Four days before admission the eye had become red and painful, and she had severe headaches on the right side. Vision in both eyes was poor. Four years previously she had had a thyroidectomy at another hospital which had since closed, so that no records were available. According to the family, exophthalmos was present previous to the thyroidectomy but had become worse following operation. Vision had been poor for a long period of years, and the records at the Brooklyn Eye and Ear Hospital showed that she had a high degree of myopia with extreme chorioretinal changes. Vision was the ability to count fingers at one foot. Previous to admission to the Kings County Hospital, the patient was examined at the Brooklyn Eye and Ear Hospital on January 20, 1940, where she was found to have ulcers of both corneae. There was marked conjunctival chemosis and proptosis of both eyes, more marked in the right eye. Both corneae were opaque.

Fig. 1 (Kravitz). Showing closure of the left eye after enucleation of the right eye.
Fig. 2 (Kravitz). Showing absence of exuberant tissue in the right orbit after enucleation.

Examination on admission revealed a well-developed woman in evident distress, and complaining of pain over the right side of the head. The eyes were markedly exophthalmic and presented irregular pupils which reacted very sluggishly to direct light. The right eye was chemotic and much injected. There was a marked ulcer of the right cornea with infiltration of the surrounding corneal tissue. The left eye presented a similar picture, except that the chemosis was moderate and the corneal erosion and infiltration were much less marked. Tension to fingers was normal in both eyes. Ocular motion was limited in all directions. Neither fundus could be made out, although the fundus reflexes were present. There was an old thickened thyroidectomy scar on the neck. The remainder of the physical examination was essentially negative.

Dental and ear, nose, and throat surveys were negative for any foci of infection. As the proptosis had become progressively worse, bilateral external canthotomies with multiple punctures of the edematous conjunctivae were performed. Following these procedures the right eye became worse and more proptosed, but the left eye improved. After a reëxamination of the sinuses on January 31, 1940, the patient was accepted for a bilateral ethmoidectomy, and the operation was performed under general anesthesia on the same day. The ethmoid cells were partially exenterated and the medial walls of the orbits and the anterior sphenoid walls were removed.

A deliberate puncture of Tenon's capsule on both sides was made and a good deal of fat removed from both orbits.

The proptosis improved bilaterally, and the patient seemed to improve. However, on February 6, 1940, the patient developed a panophthalmitis of the right eye. The cornea became gangrenous and ectatic. Four days later the eye was

enucleated. The cornea of the left eye was opaque, and moderate conjunctival chemosis was present. Vision was nil, but the eye began to recede into its socket. On February 16th, the patient began to complain of severe pain in the head. The left eyeball was very tender to the touch, the conjunctiva became injected and very chemotic, and the cornea began to show marked erosions. The chemosis and injection gradually subsided, and the cornea became staphylomatous. Enucleation of the remaining eye was advised, but was refused by the patient. Complete laboratory check-up was negative, except that a basal metabolism could never be obtained because of lack of coöperation.

During the patient's stay at the hospital, she was given foreign protein injections and sedatives. There was also a liberal use of atropine and local antiseptics.

Although the exophthalmos in toxic goiter is the result of a general stimulant circulating in the blood, one eye may be involved for an appreciable time before the other. This may occur because the sympathetic chain on one side has been sensitized to the toxin earlier, and would explain the normal left eye in case 2, in spite of the marked involvement of the right eye. We should have expected to find the blood vessels in the left eye to be spastic as a result of sympathetic stimulation. One of us[23] in a previous paper showed the abundant supply the sympathetic nervous system sends to the blood vessels of the eye and brain, but, for reasons at present not explainable, this was not found to be true.

Of further interest was the early presence of increased intraocular tension as soon as conjunctival edema presented itself, and the increase of the tension as the edema of the conjunctiva and the exophthalmos increased. With the increase in tension the cornea became steamy. Thus the picture of an acute glaucoma was present early in the progress of the disease. It seems to us that this complication may be the result of edema of the orbital tissues and interference with the venous return from the eye. This, however, does not explain the corneal ulcer, which came on simultaneously with the lagophthalmos and before increased tension in the eye was manifest; nor can its occurrence be explained by the lagophthalmos, which was not present long enough to result in a drying of the cornea. In fact, covering the cornea with a generous supply of sterile vaseline did not check its progress.

It would therefore appear that in certain cases the circulating toxins have a direct deleterious trophic effect upon the cornea. Later, the increased tension and the conjunctival edema further interfere with corneal nutrition, with a resultant spread of the ulcer and ultimate destruction of the cornea.

The early orbital congestion and the conjunctival edema are somewhat difficult to explain. Stimulation of the sympathetic nerves should result in contraction of the arteries, and so prevent, or at least have a beneficial effect on, edema; but its rapid occurrence speaks rather for a vascular paralysis, with a rapid transudation or exudation of fluid. The chronic inflammatory changes found in sections of excised conjunctivae are probably the result of a long-standing edema. It may therefore be that one of the circulating toxins has a direct paralyzing effect on the musculature of the blood vessels, or that they act via the parasympathetic system at the myoneural junction—a parasympathetic action as noted by Labbé.

On enucleation of the right eye the muscles were found to be attenuated and atrophic as a result of long-standing exophthalmos and consequent stretching.

Neither was there found an excessive amount of orbital tissue as claimed by Smelser in his cases. In this case, at least, we could have expected no favorable result from a Naffziger decapitation operation.

Contrary to the opinions of many, thyroidectomy was followed by recession of the left eye. In this case, we believe that early thyroidectomy might have caused recession of both eyes, or at least might have prevented the complications in the second eye.

In view of the work in endocrinology, the early administration of thyroxine should have been tried. Clinicians are adverse to giving thyroxine in cases of thyrotoxicosis. However, if it is true, as is generally believed, that exophthalmos is a symptom of a subactive thyroid, its use would seem to be indicated.

In addition, X-ray therapy over the pituitary region might be tried. If the views of Marine and others are correct, lessening the activity of the pituitary gland should be of benefit.

Large doses of phosphorus and calcium to lessen the irritability of the nerves is indicated.

From a survey of the available literature, it would seem that exophthalmos in man is the result of a sympathetic stimulation with a resultant contraction of Müller's orbital muscle. In addition, there seems to be a vascular paralysis resulting in orbital and conjunctival edema. This together with a direct trophic effect on the cornea results in the latter's rapid destruction.

Because of the various physiological reactions, the underlying anatomical changes in these cases of exophthalmos are different. For this reason no form of therapy, including a decapitation of the roof of the orbit, has thus far been successful in more than a small percentage of cases. Possibly application of the newer ideas in endocrinology may give better results. When other methods are failing they are at least deserving of trial.

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RETINAL TELETRAUMATISM

TRAUMATIC RETINAL ANGIOPATHY (PURTSCHER)*

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A case report is presented in which some unusual fundus changes were observed following trauma.

CASE REPORT

G. L., aged 46 years, was driving his automobile on a highway in broad daylight on January 10, 1939, when a tire blew out. The machine was struck head-on by a truck, and the patient was rendered unconscious for two hours. He was removed immediately to the nearby Somerset Hospital, Somerville, New Jersey, where he remained for one week.

Dr. Richard D. Swain of Newark examined the patient about eight hours after the accident, at which time he was conscious and rational. Dr. Swain reported "marked ecchymosis of both upper and lower eyelids. The pupils were dilated and did not react to light. The fundi were well seen. The optic-nerve head of the right eye appeared white, and many small retinal hemorrhages were observed. A scar was noted on the cornea of the left eye and the optic nerve of this eye appeared pale, without any swelling or retinal hemorrhage. The patient said he could not see light. A tentative diagnosis was made of extensive fracture, probably depressed, of the left frontotemporal region involving the nasal sinuses, and probably injury to both optic nerves near the foramina."

A neurological examination by Dr. Charles Rosenheck on January 16th showed the patient to be coöperative. His neck was rigid, a bilateral Kernig sign was present, and right musculospiral palsy. No pathological reflexes were present. In the right eye complete blindness was observed with hemorrhages and retinal edema. The optic nerve of the left eye was pale, but no other abnormal fundus findings were observed. No oculomotor palsies were observed.

The patient was transferred to the neurological service of Dr. Rosenheck at the Hospital for Joint Diseases and was first examined by me on January 20th, 10 days after the accident. Fading ecchymoses of the lower lids, more marked on the left side, were observed and diffuse discoloration of the left side of the face down to the level of the neck. The corneae and conjunctivae appeared to be normal. Both pupils were fixed in semidilatation. Vision in the right eye was limited to a crude form perception in the temporal field and in the left eye to form perception in the superonasal field. Light perception was absent in the left eye. The function of the extraocular muscles was not impaired. The red fundus reflex of the right eye was discernible only in the periphery superiorly. A diffuse, dense, edematous cloud in the posterior half of the vitreous obstructed the remainder of the eye ground (fig. 1). The vitreous of the left eye was clear, the optic nerve uniformly pale; the retina and retinal vessels appeared to be normal.

X-ray examination of the skull was negative for basal fracture. A horizontal and oblique fracture of the frontal area was reported on the left side, starting above the orbital ridge and extending up and backward in the substance of the

* From the Department of Ophthalmology, Hospital for Joint Diseases. Read before the Section of Ophthalmology of the New York Academy of Medicine, May 20, 1940.

frontal bone. Part of the fracture extended into the frontal-sinus area. The optic foramina were intact. Examination of the chest revealed an effusion on the right side with a hemothorax along the axillary border of the lung and fractures of the right second, fifth, and sixth ribs.

Laboratory examinations of urine and blood were negative.

Dr. Rosenheck's neurological report was negative.

The patient had no recollection of the accident until five days later. Apart from the bilateral blindness, his chief physical discomfort was substernal, where his chest was compressed by the steering wheel of his automobile. This pain persisted for three months. Anosmia developed soon after the accident, and up to the present time he can detect only the pungent aromas of substances like onions, peppers, or gasoline.

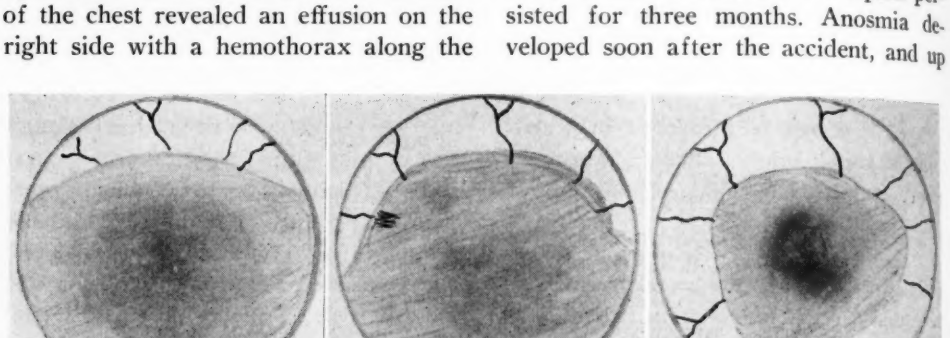

Plate 1 (Smith). Line drawings of the fundus of the right eye after chest compression—"retinal teletraumatism."

Fig. 1. Ten days after accident. Diffuse, dense, edematous cloud in posterior half of vitreous.

Fig. 2. Eighteen days after accident. Gray fog has decreased in density; suggestion of supramacular hemorrhage.

Fig. 3. Two and one-half months later. Disc barely visible.

Fig. 4. Four and one-half months later. Blood staining of the macular and supramacular areas. Supramacular arterioles are devoid of blood. Vitreous veil has shrunk to vertical rectangle. A mist over the nasal retina.

Fig. 5. Ten and one-half months later. Vitreous veil, semitransparent, is attached to the optic nerve nasally. Macular hemorrhages are replaced by fine dots and premacular pigmentation. Three hemorrhages are seen about the inferior nasal vein.

Fig. 6. Fifteen and one-half months after injury. The supramacular arterioles are obliterated. Premacular brown spots are probably blood pigment, surrounded by fine, glistening crystals. A thin, transparent veil lies in front of the disc and a thicker veil inferiorly.

Clinical course. Repeated daily ophthalmoscopic examinations of the right eye were unsuccessful until January 26th, when the fundus vessels were seen faintly in the superior and temporal one sixth of the periphery. The density of the vitre-

ous cloud had lessened. It had the appearance of a gray fog through which the disc and adjoining vessels were not visible. At its edge, temporally, two days later, was seen a suggestion of retinal hemorrhage in the supramacular region. The vitreous cloud was at no time dense nor dark enough to simulate blood (fig. 2).

On February 3d Dr. Percy H. Fridenberg reported that "only the temporal one third and superior one fourth of the periphery are seen. There is grayish, diffuse interference with the fundus reflex, nonparticulated, structureless, like a light screen; possibly a fine membrane. It is not a hemorrhage, but possibly an exudation of lymph in front of the retina with retinal hemorrhages superotemporally and inferotemporally, as observed by Dr. Rosenheck on January 16th, before the fundus view was lost. With a history of chest compression and frontal-bone fracture, an injury to the nerve within the optic foramen or Purtscher's disease must be considered. Concussion of the brain could produce a 'wet' retina (like wet brain) as is seen in Berlin's commotio retinae or Purtscher's phenomenon. Another possibility is a hemorrhage into the optic-nerve sheath, due to motion of the brain mass following collision. The prognosis must be guarded until the disc is seen with the ophthalmoscope. The vision is perception of fingers at four feet in the temporal field. The perimetric field loss is not a true hemianopsia.

"The fundus of the left eye is clear, and the retinal veins are possibly slightly increased in diameter. There is slight lack of capillarity on the disc. The temporal two thirds of the optic nerve is pale. Negative X-ray reports of the optic foramen preclude fracture and total interference with nerve conduction so that functional loss is not so permanent as would follow callus formation after a foramen fracture. Improvement of vision to 3/200 (in the superonasal field only) from an original complete loss of conductivity suggests that further increase in the acuity and visual field may be expected. The lesion is of a reversible nature, either a hemorrhage at the apex of the orbit or into the optic-nerve sheath. Another possibility is a sudden incomplete lymphorrhagia occurring where the central retinal vessels enter the optic nerve, 10 to 15 mm. behind the globe. No evidence of papilledema present or past."

When discharged from the hospital on February 11th, light sense had been recovered in the left eye. The right eye reacted to direct light reflex and barely reacted consensually, while the left was fixed to direct and more active to consensual light reflex. Temporally, the retinal vessels could be traced to the outer edge of the perimacular region. The vitreous cloud was thinner, and, while an occasional nasal vessel could be discerned, the papillary and peripapillary zones were not even faintly visible until March 24th. On this date, with a +7D. ophthalmoscopic lens, the middle third of the vitreous was seen to be occupied by a dark mass suggesting an organized hemorrhage (fig. 3). Numerous vitreous opacities were observed temporally. The disc appeared to be veiled, and the superior retinal arteries were narrowed. Vision was 2/200 and the visual field slightly improved. Vision in the left eye was 15/200, the visual field unimproved.

Four months after the accident only the peripheral one sixth of the nasal retina was visible. The inferior quadrant of the temporal retina was well defined. No retinal hemorrhages were seen.

On May 27th, the vision was improved to 4/200 in the limited superonasal field. A satisfactory view was obtained of the superior half of the temporal retina following clearing of the aforementioned

vitreous opacities. A diffuse blood staining of the retina in the supramacular and macular areas was noted. The supramacular arterioles were devoid of blood. The vitreous veil had shrunk to the shape of a long vertical rectangle hiding the nasal half of the optic nerve, and still formed a mist over the retinal details nasally (fig. 4). Vision in the left eye had improved to 20/100− eccentrically.

Ten months after the injury, the first view of the entire eye ground was obtainable. The temporal half of optic nerve were made by Dr. Donald Bogart (fig. 8).

When last examined, four weeks ago, the patient observed that the visual field temporally in the right eye had enlarged despite persistence of central visual loss, and that central acuity in the left eye had definitely decreased without any noticeable field changes. Vision O.D.=4/200; O.S.=15/200 improved to 20/200 eccentrically with −.75 D.sph. The pupil of the right eye measured 4½ mm. in width and reacted faintly to direct light only; the pupil of the left eye was fixed at 5 mm.

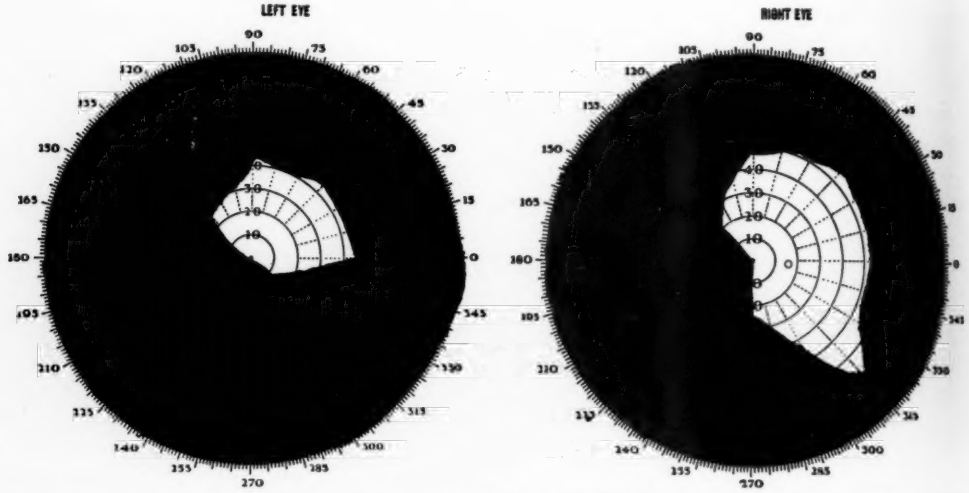

Fig. 7 (Smith). Visual fields as of April 26, 1940—three and a half months after accident. The lower half of the field, right eye, is less distinct.

appeared atrophic, and the nasal half, seen through the mist, was pale. The retina, nasally, appeared anemic, and three dark, broad hemorrhages were seen above and below the inferior nasal vein five disc diameters from the optic nerve. Hemorrhages in the macular zone had been replaced by fine white dots and premacular pigmentation. The vitreous curtain had thinned out like a transparent veil originating from the nasal half of the optic nerve and extending into the posterior third of the vitreous in the pupillary line (fig. 5).

On March 6, 1940, fundus photographs to direct light and faintly reacted consensually. The fields of vision are shown in figure 7. The edges of the optic nerve of the right eye were irregular and the disc was atrophic except nasally. The arterial tree was narrowed throughout, and the diameter of the veins had definitely decreased. The supramacular arterioles were entirely obliterated. Two brown spots were seen in the premacular area, probably blood pigment, surrounded by fine glistening crystals. Degeneration of the retina and choroid was observed superior to the disc from the 11- to the 3-o'clock position. With a +7D. ophthal-

moscopic lens a thin, transparent vitreous veil about one disc diameter wide and one-half diameter high, appeared in front of the inferior nasal quarter of the optic nerve. Nasally the veil had a border similar to the eastern seaboard on a United States map, and inferiorly a peninsula-like extension. Beneath it lay another transverse but denser veil. The main opacity was fixed and while it moved with the eye its connection with the retina, disc, or the lower veil could not be definitely established (fig. 6).

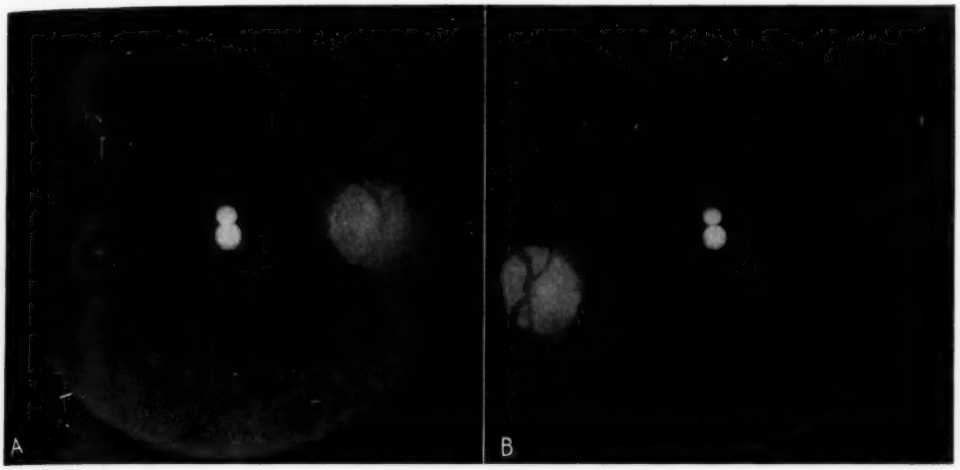

Fig. 8 (Smith). A, right eye: A thin veil obscures the optic nerve nasally. There is narrowing of the arterioles and the macular vessels are obliterated. The two pigment spots and crystals depicted in figure 6 are also shown. B, left eye: The macula is normal. There is narrowing of the arterial tree with optic-nerve atrophy.

Primary optic atrophy of the left nerve was evident. The macula was normal; the retinal arterial tree narrowed. The vitreous was clear except for a shadow cast by an old corneal opacity.

Comment

Retinal changes following direct blows to the globe are of common occurrence. Berlin's transient commotio retinae following contusion of the eyeball is well known. Purtscher[1] called attention to the fundus changes following severe head injuries. The terms he used were "traumatic retinal angiopathy" or "lymphorrhagia retinae." Purtscher's disease is not a definite clinical entity, and several authors have reported cases presenting similar and even more extensive eye-ground phenomena after abdominal or thoracic compression injuries or following fracture of the vertebrae, without direct violence to the head. According to Purtscher's theory, the head injury induces compression of the spine in its longitudinal axis, which, in turn, produces increased intracranial pressure. This pressure forces the spinal fluid through the intervaginal (subarachnoid) space into the nerve head, and along the retinal vessels, extravasating into the retinal tissue through the ruptured perivascular lymph spaces.

In view of the fact that the intervaginal (subarachnoid) space is not a true cavity, Purtscher's hypothesis is difficult to accept. One would have to assume that an increase above the normal volume of fluid in this space follows the momentary increase of intracranial pressure. Best[2] further refutes Purtscher's premise on

the basis that fluid forcibly displaced far into the retina would rupture this structure and its vessels. No experiments have been reported to corroborate the contention that lymph can be projected into the retina or vitreous. The exact mechanism that produces the retinal hemorrhages and exudates is not known. Friedenwald[3] believed the retinal changes to be due to fat embolus. This view has also been expressed by Urbanek[4] and Loewenstein[5].

Savitsky and Gross[6] presented a preliminary report in abstract before the New York Neurological Society on an interesting case that has not appeared in the ophthalmological literature. An autopsy was performed upon a patient who died 21 days after being struck by an automobile. "Sections of the right eye showed round structures within the retinal layers which reacted to the stain for fat. There were subarachnoid hemorrhages, especially in the right parietal region, and extensive laceration of the middle and inferior temporal convolutions on the left." When the authors publish their final report on the eye pathology, theirs will probably be the first case on record with ante-mortem and post-mortem studies.

Stokes[7] has reported retinal vascular changes after traumatic injury of the chest and cites 11 cases in the literature due to this type of accident. The fundus pictures were identical and could not be differentiated from those originally attributed to head injuries. Willers,[8] experimenting on rabbits, was able to demonstrate, after trephining of the skull, that the intracranial pressure could be increased by thoracic and abdominal compression, which produced a bulging of the brain through the prepared opening.

Bedell[9] recently presented three cases under the title of "Traumatic retinal angiopathy": the first, following fracture of the third and fourth lumbar vertebrae; the second, after compression of the chest, traumatic asphyxia, and fracture of the transverse processes of the seventh, eighth, and ninth dorsal vertebrae; and the third, complicating head injury. He has compiled a bibliography of 40 cases in which the eye-ground pathology could be considered as traumatic retinal angiopathy.

The unusual fundus feature of the case reported here was the fog or veil that occupied the posterior vitreous for many months, with the angiopathic changes confined to the macula and inferonasal vessels. Vogt[10] believed that the cloudy exudates in his cases were in the internal limiting membrane of the retina. Bedell compared a fundus photograph of his third case with the drawings in Chou's[11] report, and suggests "the lesion may be in or about the vitreous and not in the retina." While the vitreous changes in my case were predominant, it must be assumed that the primary pathology was in the retina.

The purpose of this presentation is to emphasize the possible importance of the secondary vitreous involvement (exudation, hemorrhage, or connective-tissue formation) in the ophthalmoscopic picture, and to propose that many cases classified in the literature as Purtscher's disease be brought into one general group. In view of the variety of head, chest, abdominal, and vertebral injuries distant from the eye that may produce retinal and vitreous changes, the general designation of "teletraumatism of the retina" suggested by Fridenberg[12] seems more descriptive than traumatic retinal angiopathy.

The loss of vision in the left eye followed fracture of the frontal bone, probably producing a hemorrhage far back in the orbit, with subsequent clot formation and incomplete optic-nerve atrophy. While this injury also represents a form

of indirect violence, no changes were observed in the retina or vitreous. Its occurrence in a patient, the pathology of whose right eye was attributable to chest compression, is worthy of note.

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PRESERVATION OF CONVERGENCE WITH PARALYSIS OF ALL LATERAL MOVEMENTS IN A CASE OF INTRAMEDULLARY TUMOR OF THE PONS*

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In 1863 Prevost[1] observed that patients with cerebral apoplexy often turned their eyes toward the affected side and that this was usually temporary. Landouzy[2] supplemented these observations, and it was then found that this phenomenon, since known as conjugate deviation, resulted from destructive lesions in the cortex. In 1879 Grasset[3] noted that affections of the pons may cause conjugate deviation, but in these cases the deviation was toward the unaffected side. It was thus inferred that associated lateral movements of the eyes originate in the cortex and are transmitted to the pons, the pathways crossing on the way between cortex and pons. Later experiments showed that these side-movements originated in the frontal, temporal, and occipital lobes, but even today their pathways from the cortex to the pons are not definitely known.

From clinical observation it was learned that in cases of pontine lesions it is the rule for convergence to be preserved, whereas lateral gaze to either or both sides is paralyzed. One could, therefore, assume that the cortical impluses pass down through the pons to the abducens nuclei, and then back to that portion of the oculomotor nucleus supplying the internal rectus for the opposite side. The fact that convergence is rarely disturbed in these pontine paralyses of lateral movements shows that convergence impluses are transmitted to the internal rectus by pathways separate from those subserving adduction in lateral movements. It is evident, however, that another crossing must occur in order that the internal rectus on the opposite side be innervated. Where this crossing takes place is still a matter of speculation, and it is even assumed by some that the internal-rectus center in the oculomotor nucleus may be on the same side as the stimulated abducens nucleus, so that this final crossing may be peripheral to the nucleus.

Paralysis of associated lateral movements may result from failure of volitional innervation; but lateral movements may still be obtained through reflex stimulation, particularly through the vestibular apparatus and through optokinetic impulses originating in the occipital lobe (Bielschowsky[4]). On the other hand, in pontine cases of paralysis of associated lateral movement there is frequently faulty response to vestibular stimulation (Bielschowsky,[4] Bárány[5]). It is known that the vestibular apparatus exercises a continuous tonic effect on the eye muscles, chiefly through the posterior longitudinal fasciculus, which is an important association pathway for the various ocular muscles. It has also been assumed that there were association centers for lateral movements in the pons although such centers have never been demonstrated anatomically. It is now quite generally believed that there is such a center for lateral movements in the immediate vicinity of the abducens nucleus. Probably all impulses for lateral movements are synthesized and integrated in this center. It is further assumed by some (Spiegel and Scala[6]) that this center is closely related to, if not identical with,

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the vestibular center for lateral movements.

The central-nervous-system control of the ocular movements remains a difficult physiological problem, and in clinical work the abnormalities of this mechanism are still baffling. This is particularly true of lesions beginning in the brain stem, in which disturbances of ocular movement may be the earliest manifestation. Unilateral paralysis of lateral gaze is not uncommon, but bilateral paralysis of lateral movements with preservation of convergence is rare—indeed, in our own experience, it is unique. For this reason the following case is reported:

Case report

History. T. S., female, aged 47 years, was admitted to Wills Hospital on December 11, 1939, having been referred by Dr. H. K. Irwin, who stated that he had first seen the patient July 7, 1938, when she complained of gradual diminution in vision for both distance and near. He noted paralysis of conjugate movement to the right, and a partial paralysis of the right facial nerve. He saw her again on November 3, 1939, at which time there was complete paralysis of conjugate movement to either side.

On admission the patient gave the following history: Eighteen months ago the eyes itched and were red, and she noticed that the vision was foggy. The vision continued to fail, and after a few months there were short periods during which she could not see objects even within a few inches of her face. She gradually developed pain in the forehead and in the temporal regions, which seemed more intense during her menstrual periods. Prior to admission to the hospital her vision improved, but she would see double at times, especially when tired. She has a nervous habit of blinking the left eyelids and turning her eyes upward, and sleeps with the right eye open. She noticed that during the past few weeks she has been unable to turn her eyes from side to side.

Observations in the Hospital

Mental status. The patient was moderately coöperative, and showed no gross defects in memory, orientation, or general grasp of knowledge. No definite emotional disturbances were observed.

Somatic status. She was moderately well nourished. Her pulse was 80; blood pressure, 130/80. The skin was normal, and there was no lymph-node enlargement. The liver was moderately enlarged and slightly tender. There was a systolic murmur in the third left interspace, close to the sternum, probably due to early aortic disease.

Neurological status. In walking the head was held fairly stiff with the chin directed to the right. There was no loss of associated movements of the arms nor disturbances of gait; and no corneal anesthesia or other sensory involvement of the fifth nerve on either side. The masseter and temporal muscles were well innervated, but on opening the mouth the jaw deviated to the left. There was an incomplete peripheral facial palsy on the right, involving all branches of the nerve on that side, and accompanied by fibrillary tremors of the right side of the face especially the lower portion, and some fibrillary tremors of the opposite side. Hearing was unimpaired. The soft palate was deviated to the left; the tongue was small and fibrillating, but firm. Examination of the extremities revealed no motor, trophic, tonic, sensory, or reflex changes. On extension the hands were on the same level at first and then the right hand began to droop. In the finger-to-nose and succession tests there was bilateral impairment, more marked on the right side. In the heel-to-knee tests there was bilateral impairment, more marked on the left side.

Eye studies. The vision was O.D. 6/21−1; O.S., 6/15−2, improved to 6/15 + 2 and 6/9, respectively, with present glasses. Both globes were moderately prominent, the exophthalmometer reading being O.D. 19 mm., O.S. 18 mm. The right palpebral fissure was wider than the left, and the right eye winked imperfectly and could not be entirely closed. In the primary position the eyes appeared somewhat convergent, and showed a slight, slow, up-down movement that was more pronounced when one eye was covered. Both eyes were perfectly stationary under cover. Vertical movements were good, both eyes diverging slightly on elevation. Neither eye could be moved laterally, when tested either alone or together, on command or otherwise. Convergence was good and full, the eyes slowly returning to the primary position. The pupils were equal and active to light, and convergence and accommodation were normal. The tension of each eye was normal to palpation.

The ophthalmoscope revealed clear media in both eyes and no abnormalities except a few clumps of pigment down and in from the left disc.

With the Maddox rod there were 13 degrees of esophoria at 6 meters, and at 33 cm. 3 degrees of exophoria and 3 degrees of left hyperphoria. There was no spontaneous diplopia, but diplopia could be developed with a red glass, the patient showing double images in all fields. These separated horizontally and vertically as the eyes were turned down, being on a level and very close together in the upper field. In the horizontal and lower fields the image of the left eye was below and to the left.

The visual fields were full in all directions, and the blind spots were not enlarged.

Irrigation of each ear with cold water caused no movement of the eyes.

Laboratory studies. X-ray study of the skull was essentially negative. The blood chemistry, blood count, urinalysis, and blood Wassermann were negative. The spinal-fluid pressure on December 12, 1939, was 240 mm. of water, but four days later it was only 170 mm. of water. A detailed examination of the spinal fluid was negative.

Course. The patient was discharged on request on December 22, 1939, and was admitted to the Graduate Hospital on January 22, 1940. At this time she showed considerable mental disturbance, with disorientation, psychomotor hyperactivity, and auditory and visual hallucinations. The examination of the cranial nerves revealed the same findings as in December, but in addition there was a bilateral papilledema of 4 to 5 diopters in the right eye, and 5 to 6 diopters in the left eye. There was ataxia of all four limbs, and the patient was unable to walk.

Routine laboratory studies and X-ray films of the skull were again negative.

A diagnosis of intramedullary tumor of the pons was made, and on January 27, 1940, Dr. R. A. Groff performed a posterior craniectomy. After splitting the vermis, a tumor springing from the floor of the fourth ventricle was observed. The growth was yellowish, fairly tough, and moderately vascular. A tag of tissue was found blocking the aqueduct of Sylvius. A portion of the tumor tissue was removed. The patient died the same day. Death was due to respiratory failure. Autopsy was refused. The histological diagnosis of the removed specimen was *astrocytoma.*

Comment

In this case the preservation of the function of the internal recti for convergence, but not for adduction, in lateral movements is closely related to the problem of a center for convergence in

the brain stem. The existence of a brain-stem center for convergence has been suspected and postulated for many years. Our knowledge regarding this subject has, from several directions, been considerably enriched in the last few decades.

Brouwer[7] demonstrated that, with the appearance in the phyletic scale of the ability to converge, the only new addition to the oculomotor complex is the medially placed nucleus of Perlia, and on this evidence he based the assumption that this nucleus is in reality the center of convergence in the pons.

The epidemic of encephalitis has left many patients with complete failure of convergence. In these patients, the lateral associated movements of the eyes are maintained perfectly, the internal recti of each eye acting in lateral conjugate gaze, but either partially or totally failing to produce the convergence movement of the eyeball. In other words, in these cases only the *center for convergence* fails to function.

The existence of a center for convergence is further proved by cases in which there was failure of lateral movements, but preservation of convergence. Such cases have been reported in connection with vascular lesions, brain tumors and other space-consuming lesions, encephalitis, and multiple sclerosis. A number of these cases came to autopsy and will be briefly mentioned.

diMarzio and Fumarola,[8] in a paper on the disturbance of associated ocular movements, discussed 29 cases with autopsy findings collected from the literature. Most of this material is of little value for purposes of localization, for no mention is made of convergence, and the lesions found at autopsy are either too diffuse or but poorly described. However, a few cases are worth mentioning:

1. Wilbrand and Saenger.[9]—Paralysis to the left, with convergence intact. Autopsy: Tumor the size of a nut in the pons.

2. Raymond and Cestan.[10]—Bilateral paralysis of the external recti, with normal convergence. Autopsy: Tubercle in the upper portion of the pons. The pyramidal tracts and the nuclei of the third and fourth nerves were normal.

3. Ewald.[11]—Associated paralysis to the left and normal convergence. Autopsy: Tubercle the size of a pea in the pons.

4. Noceti.[12]—Paralysis to the left, with convergence intact. Autopsy: Tubercle in the right eminentia teres.

5. Grasset and Gaussel.[13]—Bilateral paralysis of associated lateral movements, with conservation of convergence. Bilateral facial paralysis, ataxia of upper extremities, cerebellar type. Autopsy: Multiple tubercles in the left hemisphere of the cerebellum, in the pons, and at the base of the fourth ventricle, with destruction of the two nuclei of the abducens.

From the standpoint of clinicopathological correlation, the following three cases from the literature deserve special consideration:

Wernicke's case.[14]—A man aged 30 years, suffering from syphilis and tuberculosis of the lungs, exhibited an unsteady gait, hemiparesthesia, and complete paralysis of lateral ocular movements. The upward and downward movements, convergence, pupillary reactions, and accommodation were normal. The other cranial nerves were normal. *Autopsy findings:* A circular *tumor* 2.5 cm. in diameter, located exactly in the midline of the pons, below the floor of the fourth ventricle. The tumor formed an elevation in the region of the nucleus of the abducens, causing a split in the median sulcus. Through this split, which measured 2 cm. in length and 3 cm. in breadth, the subjacent tumor was readily visible.

Berthelsen and Rönne's case.[15]—This patient suffered from an alcoholic polio-

encephalitis. Clinically, the patient exhibited somnolence, speech disturbance, failure of the pupils to respond to stimulation, and bilateral associated paralysis of lateral gaze to both volitional and reflex stimulation. The upward and downward movements and convergence were normal. The patient had fits of spasmodic convergence. *Autopsy findings:* Arteriosclerotic degenerative changes in the cortex. In the pons, an isolated degeneration of both sides of the posterior longitudinal fasciculus at a level between the oculomotor and abducens nuclei, the latter doubtless being capable of function.

Spiller's case[16] of ophthalmoplegia in ternuclearis ended in death from cardiovascular disease. Clinically, there was complete loss of action of the internal rectus in both eyes for lateral movements, but convergence was normal. All other extraocular movements were normal. The pupils were large and reacted promptly to light and convergence. *Autopsy findings* consisted of an area of softening of the tegmentum at the level of the corpora quadrigemina. Careful histologic study revealed a destruction of the lower part, and a degeneration of the upper part, of the left trochlear nucleus. The posterior longitudinal bundle was destroyed on the left and much invaded by the softening of its ventral part on the right. The oculomotor nuclei were not involved on either side, and the nerve fibers from these nuclei which passed through the area of softening appeared to be normal. The abducens nuclei and their nerve fibers were likewise uninvolved. Spiller concluded that convergence was preserved because the anterior part of the oculomotor nucleus was not affected by the area of softening.

In addition to clinicopathological studies, some clinical observations are of value. Thus Antoni[17] described a case in which the internuclear connections over the posterior longitudinal fasciculus were broken by a lesion. In this instance the eyes, when turned to one side, showed a failure of adduction of the contralateral eye, with resulting divergent strabismus and diplopia, with nystagmus of considerable amplitude. This indicated a paralysis of the internal rectus. There was, however, a maintenance of convergence in which both internal-recti muscles acted normally. This sort of disturbance is clearly the result of an interference between the center for lateral gaze and the internal-rectus segment of the opposite third-nerve nucleus. The presence of a retained convergence reaction, and the fact that vestibular irritation failed to produce a nystagmus in the involved eye, indicated that the lesion was situated in the connecting fibers between the nuclei. Antoni found this situation in three patients, all of whom were suffering from multiple sclerosis.

Preservation of convergence with bilateral paralysis of gaze may occur as a congenital anomaly, as in cases reported by Dupuy-Dutemps[18] and others, which correspond almost exactly with the case herein reported.

The aforementioned anatomic and clinical data would seem to make it probable that the collection of nuclear matter known as Perlia's nucleus is responsible only for the control of the internal-recti muscles in convergence, separate from the internal-rectus segments that are concerned with the movements of lateral gaze. This hypothesis has received almost universal acceptance, although definite pathological evidence is still lacking.

The connections of Perlia's nucleus must be construed as follows:

(a) A direct connection with the nucleus of the branch destined for the internal-rectus muscle, since this branch is the final common path.

(b) A connection with the motor cor-

tex through the corticobulbar tract for volitional movement. No definite center has been localized in the cerebrum for such movements, although stimulation experiments sometimes produce convergence.

(c) Connection with the visual cortex in the occipital lobe by way of the occipitomesencephalic projection system. This would account for the preservation of convergence and the innervation of both internal-recti muscles in response to visual stimuli, even though there is failure of response to volitional motor stimulation.

In the case just reported, it would seem that the lesion involved the posterior longitudinal bundles caudal to the level of the third-nerve nuclei, and possibly also both centers for lateral deviation of the eyes. Such a lesion would explain all the findings in this case. As a result of this lesion, all lateral movements of the eyes were abolished. That the internal-rectus nucleus and its nerve remained uninvolved is proved by the preservation of convergence. Such a formulation is in keeping with the fact that the other components of the third-nerve nucleus likewise remained unimpaired. Furthermore, involvement of the posterior longitudinal bundles and also the centers for lateral movement is suggested by failure of response to caloric stimulation.

Conclusions

Based on the analysis of the syndrome of the preservation of convergence with paralysis of lateral gaze, it may be stated that such a syndrome is of localizing value in that it points to involvement of the pons. This concept may be useful in the early localization of brain tumors and other focal lesions in the pons.

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NOTES, CASES, INSTRUMENTS

SYNTHETIC PLASTIC MATERIAL FOR IMPLANTATION INTO ORBIT FOLLOWING ENUCLEATION*

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Although the implantation of gold balls into the orbit following enucleation is more satisfactory than that of fat, glass, paraffin, or other substances, the movements of the prothesis have been limited. Moreover, gold balls are heavy and expensive. McCrea (1938) was confronted with this problem in the field of urology and found that a new plastic material commercially known as "Lucite" was useful for testicular prothesis. Thiel (1939) also reported favorable results with a synthetic plastic known as "Polyviol" in orbital implantation into Tenon's capsule after enucleation.

Because of the importance of the problem in ophthalmology, experiments with various shapes and sizes of synthetic plastic compounds such as "Lucite" and "Plexiglas" have been performed. The physical, chemical, thermal, and optical properties of these substances have already been worked out by the manufacturers.

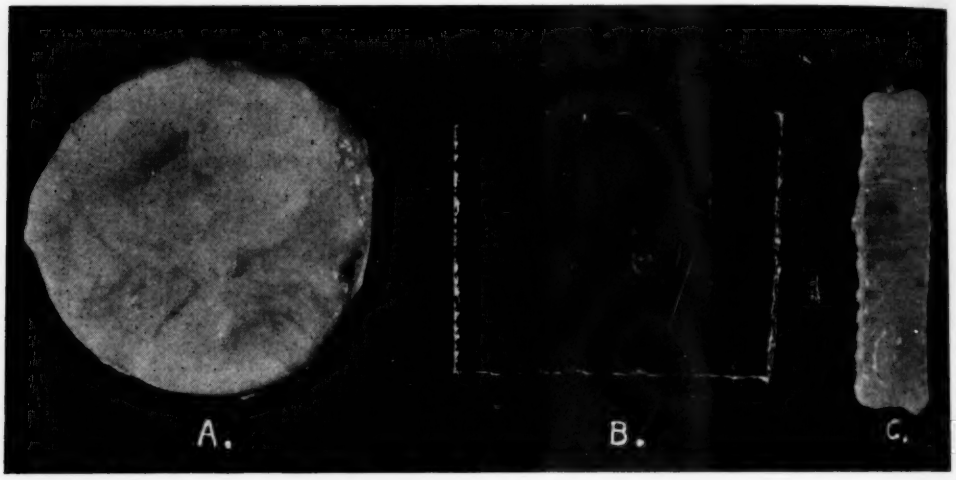

Fig. 1 (Berens and Rothbard). A, Lucite. B, Plexiglas. Specimens removed after 246 days of subcutaneous implantation. C, Plexiglas, specimen removed after 86 days of intraperitoneal implantation in a rabbit.

Experimental. To be certain that the material would not be absorbed by nor irritating to the tissues, a study of the effect of these compounds on the animal body was carried out in a small group of rabbits. Under aseptic conditions the plastic materials were placed in the subcutaneous tissues, pleural and peritoneal cavities, and in the anterior chamber of

*From the Department of Research, New York Eye and Ear Infirmary, and the Department of Pathology, Cornell University Medical College. Aided by a grant from the John and Mary R. Markle and Ophthalmological Foundations. Presented before the Section on Ophthalmology, New York Academy of Medicine, April 15, 1940.

the eye, and the animals were permitted to survive from 40 to 246 days. There was no evidence of an inflammatory reaction at any of these sites during the period of observation. The animals gained weight, appeared alert, and were active at all times.

When the specimens were removed, the size, shape, and contour were the same as

Clinical. The implants are obtainable in 12-mm., 14-mm., 15-mm., 16-mm., and 18-mm. sizes. The form selected as the most desirable is quadrilateral and pyramidal in shape, rounded at one extremity, and tapered to a blunt point at the other (fig. 2). Implants may also be obtained in the form of spheres and cones (fig. 3).

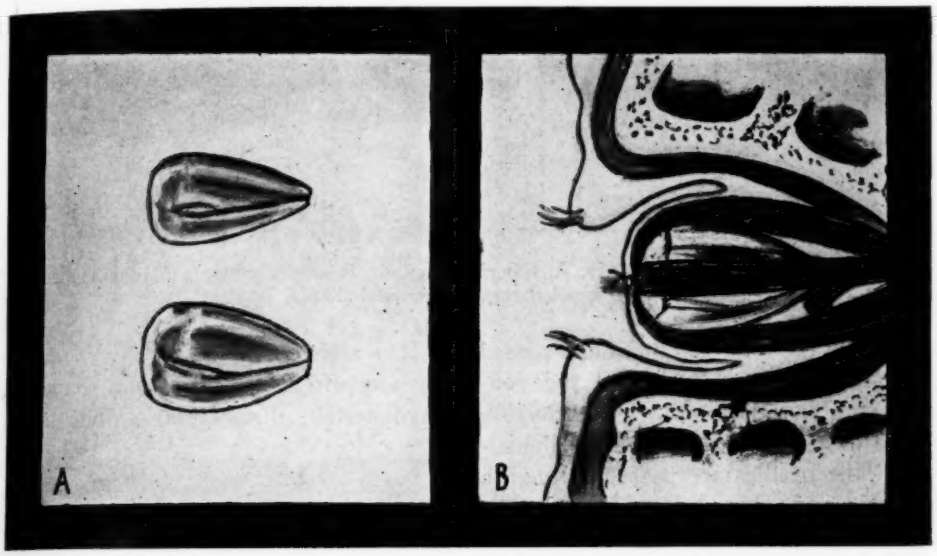

Fig. 2 (Berens and Rothbard). A, implant of plastic material for enucleation. B, implant in place in Tenon's capsule.

on insertion (fig. 1). A thick, white layer of fibrous connective tissue surrounded each specimen, and there was also a rich vascular supply about it. The peritoneal and pleural surfaces were smooth except for a few fibrous adhesions, and the viscera were normal.

The autopsy findings on the organs and tissues were essentially negative. The heart, lungs, liver, spleen, kidneys, and eyes were examined microscopically, and no abnormality which could be attributed to absorption of any constituents of the plastic substances was observed. These findings are not surprising in view of the lack of local irritation produced by the "Lucite" and "Plexiglas."

Sterilization is easily carried out by boiling or by placing the material in solutions such as alcohol or other antiseptics. Immersion for 10 minutes in one of the following solutions is recommended for sterilization: Merthiolate 1:1,000, Hexylresorcinol (S.T. 37) 1:1,000, Metaphen 1:500, or bichloride of mercury 1:400.

The method employed for implantation was that described by Berens in 1937. After enucleation of the eyeball, the implants, which are flattened on the sides to conform to the recti muscles, are placed in Tenon's capsule with the apex directed toward the apex of the orbit. A running, double-armed suture of no.-5 twisted, paraffinized, black silk is passed first

through Tenon's capsule at the level of the muscular attachments and then through the conjunctiva 3 mm. above the internal canthal ligament. Each muscle is held with artery forceps; the suture is passed in and out of Tenon's capsule including the four ends of the cut recti muscles in the bite. One needle is passed through Tenon's capsule and the conjunctiva above the point of introduction of the first needle, thus crossing the sutures. The needles are passed through a small piece of rubber tubing, 3 mm. apart, so that the suture may be easily removed.

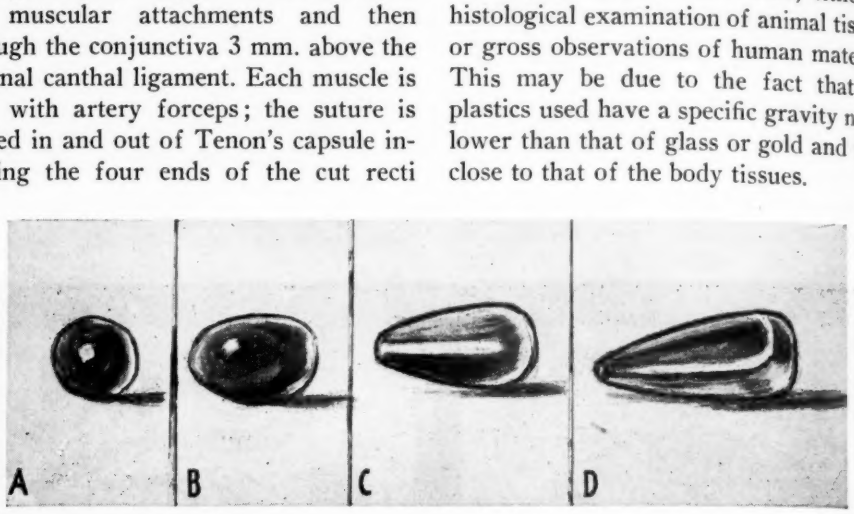

Fig. 3 (Berens and Rothbard). A, spherical implant. B, ovoid implant. C, cone-shaped implant. D, quadrilateral, pyramidal-shaped implant.

After the plastic implant is introduced, and after making sure that there is a firm closing of Tenon's capsule, the sutures are tied. The conjunctival incision is closed with a running 0000 plain catgut suture. A pressure dressing, which is held by adhesive, and a bandage are applied (fig. 4).

Up to the present time eight plastic implants have been inserted in the orbital cavities of patients, and no untoward effects have been observed.

Although the plastic compounds have proved to be nonirritating to both animals and human beings, they have been under observation for not more than nine months and, therefore, it is possibly too early to draw final conclusions concerning their ultimate value. To date, however, no irritating qualities nor absorption of the plastics has been noted, either in histological examination of animal tissues or gross observations of human material. This may be due to the fact that the plastics used have a specific gravity much lower than that of glass or gold and very close to that of the body tissues.

It is also too early to state whether or not a quadrilateral, pyramidal shape may have certain disadvantages, but in the eight human orbits in which the implants* have been retained, good motility of the

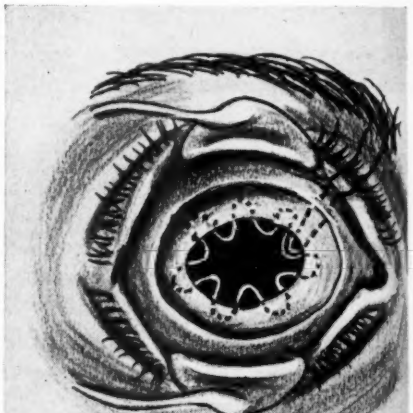

Fig. 4 (Berens and Rothbard). Purse-string suture placed in Tenon's capsule and recti muscles. Conjunctival wound is not closed.

* The implants are made by V. Mueller and Company, Chicago, Illinois.

prothesis has resulted. It would seem that the pyramidal shape should tend to stretch the muscles more than the spherical shape, and that pivoting on the point of the implant should result in better average motility.

Certainly, for many patients the fact that the material cannot be broken is an added advantage, and further studies of its possibilities seem justified.

Conclusions

1. Synthetic plastic compounds, such as "Lucite" and "Plexiglas" cause no irritation to human or animal tissues nor are they absorbed or changed in any manner.

2. Good motility of the prothesis has resulted after implantation of the quadrilateral, pyramidal shaped forms.

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1300 York Avenue.

Acknowledgment is made to Röhm and Haas, Philadelphia, for supplying us with "Plexiglas" for use in the experiments, and to E. I. DuPont de Nemours, Arlington, New Jersey, for "Lucite."

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THE POSTERIOR APPROACH FOR THE REMOVAL OF MAGNETIC INTRAOCULAR FOREIGN BODIES*

Fleming A. Barbour, M.D.,† and F. Bruce Fralick, M.D.
Ann Arbor, Michigan

Most intraocular injuries are incurred in industry, and it is highly important, from the patient's standpoint, that every effort be made to preserve the injured eye so that he may continue to pass industrial visual-requirement tests and maintain his employability. A detailed method of removing magnetic foreign bodies from the vitreous chamber is presented. It has been used by us for the last several years and we believe that it offers several distinct advantages.

Before surgery can be considered, several questions about the injured eye must be answered. The cornea and sclera should be very carefully studied by means of loupe and slitlamp for evidence of scarring from foreign-body penetration. Since tiny missiles may enter the eye and leave a minute scar that is almost invisible, a roentgenogram of the posterior-anterior and lateral projections of the orbit should be taken in every case in which there is a suggestive history. Occasionally the subsequent value of X-ray evidence in the court room cannot be overestimated. If evidence of a foreign body is seen on the test films, then one of the several methods of exact localization, such as the Sweet procedure, should be carried out.

Fortunately, most metallic foreign bodies are magnetizable. Of the alloys, magnesium steel has very slight magnetic properties. Chromium and tungsten alloys are not markedly different from ordinary

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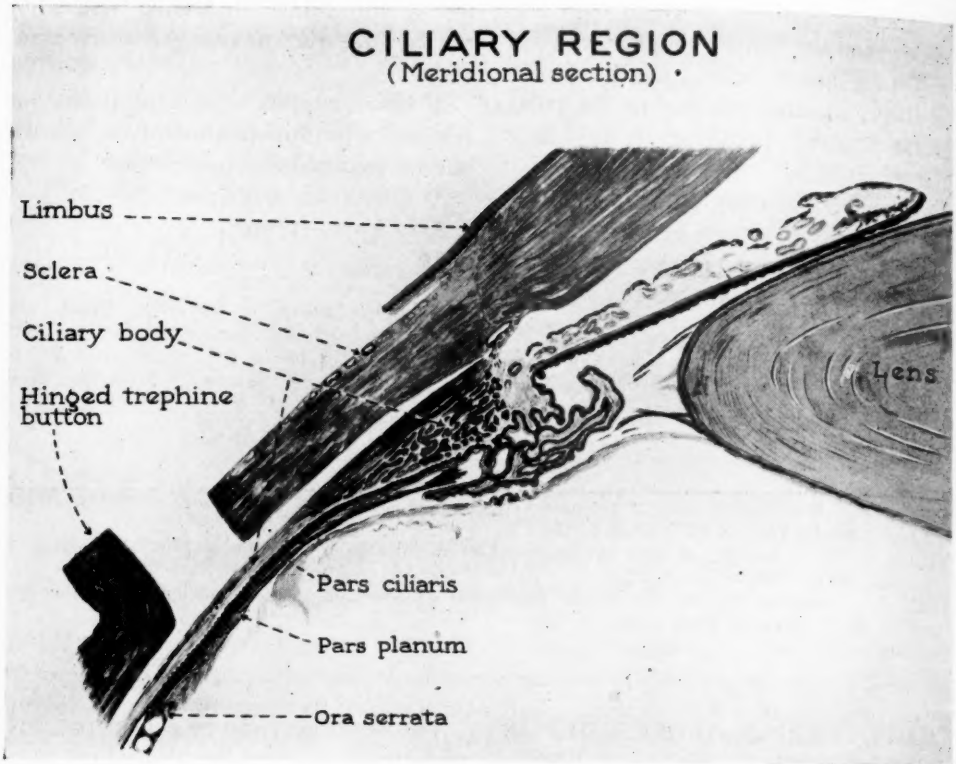

Fig. 1 (Barbour and Fralick). Meridional section of the ciliary region showing pars ciliaris and pars planum, and the site of the hinged trephine button in the removal of intraocular foreign bodies from the posterior chamber.

steel in this respect. Steel of high nickel content is only moderately magnetizable. Careful inquiry will often establish the exact nature of the missile.

Generally speaking, the foreign body should be removed as soon as possible after the injury. If, however, signs of marked iridocyclitis are present when the patient is first seen, it is better, in our opinion, to wait until the reaction has quieted down, since an inflamed eye does not tolerate operative trauma well.

When the foreign body is lodged in the vitreous chamber, we prefer to extract it through the pars planum of the ciliary body, as Verhoeff* has advised. The pars planum measures about 4.5 to 5.0 mm. posterior to the ciliary portion. This places the ora serrata about 7.5 to 8.0 mm. from the limbus, and it is at this point that the retina proper terminates and is more firmly attached than anywhere else except at the entrance of the optic nerve. The pars-planum portion of the ciliary body is only several cells thick and rather adherent. The vascular elements of the pars planum consist mainly of relatively few veins, which run parallel in a meridional direction to drain into the vena vorticosa. There is no choriocapillaris in this area. Thus, the pars planum presents an area through which the vitreous cavity can be entered with minimum trauma to ocular structures.

After using several methods designed

*Verhoeff, F. H. Concerning magnetic intraocular foreign bodies and their removal. Amer. Jour. Ophth., 1932, v. 15, Aug., p. 685.

to pierce the sclera, in order to reach the foreign body, we found that a small trephine hole through the sclera over the pars-planum portion provided an adequate opening for easy delivery and promoted rapid healing (fig. 1). The proper area for trephining can be readily determined by measuring 5.5 mm. to 6.0 mm. posteriorly on the circumference of the globe in the proper meridian, and using this point as the center of the trephine hole. This provides a maximum margin of 2.0 mm. anteriorly and posteriorly for still remaining within the pars planum.

The operation is performed as follows: The patient is prepared as for any intraocular operation. Four-percent cocaine is instilled for local anesthesia. The Van Lint type of akinesis is used, and 1 to 1½ c.c. of 1.5-percent procaine is injected retrobulbarly. The conjunctiva and capsule are incised concentrically with the limbus and about 10.0 to 12.0 mm. posterior to it, with the elevation of a conjunctival flap to expose the pars-planum area in the meridian that is nearest to the foreign body (fig. 2). One or two fine silk sutures are placed with a corneal needle to hold the scleral button. The episcleral tissue should be picked up by the suture close to the site of the hole, the suture passed over the button, and then again through the episcleral tissue on the opposite side of the hole. The ends are brought out through the conjunctiva and tied. A 1.5- to 2.0-mm. trephine opening is then made, with hinging of the button as the sclera is pierced, and using extreme care to prevent traumatizing the uvea or entering the vitreous cavity with the trephine blade. The hand or giant magnet is then introduced with the tip over the trephine hole, and the current is turned on and off intermittently. Frequently the foreign body will appear in the hole and, if sharp, may cut its way through the thin portion of the ciliary body to present itself for easy removal. If the foreign body does not appear, it is necessary to pierce the pars planum and enter the vitreous cavity by means of a meridional incision made with a cataract knife. This incision parallels the veins and induces

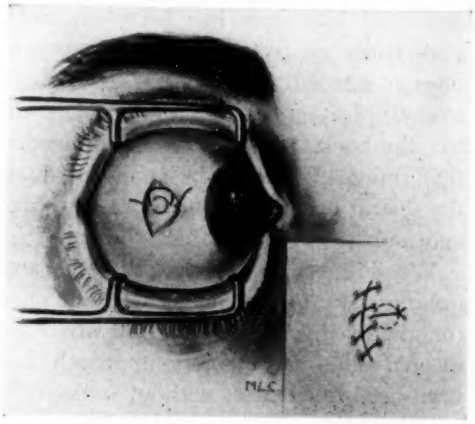

Fig. 2 (Barbour and Fralick). Showing the site of the hinged trephine button over the pars planum of the ciliary body and the manner of inserting the episcleral suture that keeps the hinged trephine button in place.

very little bleeding. If repeated pulls with the magnet do not produce the foreign body a small tenotomy hook can be introduced into the hole, the handle maintaining contact with the magnet.

If the missile is too large for removal through the trephine hole, the opening can be enlarged with scissors by cutting sclera only. After the foreign body is obtained, prolapsed vitreous, if any, is excised. The scleral button is replaced and held there by the sutures previously placed for that purpose. The conjunctiva is then closed with running silk.

For the next 24 hours the same postoperative care is given as after cataract extraction. The patient may be discharged from the hospital as soon as the eye is quiet and the sclera sufficiently healed. This period varies from three to seven days. Foreign-protein therapy in the form

of typhoid-H antigen is given. Any iritis that may be present is given the usual treatment, and 1,500 units of tetanus antitoxin are administered routinely.

In several patients in whom the ophthalmoscope revealed the foreign body imbedded in the retina, an exception to the described technique has been made. In such cases no Sweet localization procedure is needed. The sclera is trephined over the foreign body if the latter is not too far back. It has been recommended that retinal diathermy be applied around the scleral opening in such a case to prevent subsequent retinal detachment.

We do not believe that there is any greater risk of inducing sympathetic ophthalmia by this method than by any other means. The pars-planum approach has been used in 14 cases without subsequent evidence of sympathetic ophthalmia.

SUMMARY

A method has been presented for removing magnetizable foreign bodies from the vitreous chamber. The operation is simple and readily delivers the foreign body. Further trauma to the iris and lens is avoided. There is less trauma to the eye by this method than is the case with other types of posterior approach. If careful asepsis is observed there is no greater incidence of infection than when the anterior route is used to remove the foreign body.

DIVERGENCE PARALYSIS WITH AUTOPSY REPORT*

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Los Angeles

In 1883 Parinaud[1] described and properly evaluated this rarest of the conjugate palsies. In 1899 Duane[2] published his classical description, which gave divergence paralysis an established clinical picture.

The syndrome has since been reported, ably described, and discussed by many clinicians. The etiology, pathology, and physiology have more recently been discussed and reviewed by Bruce,[3] Chambers,[4] Bielschowsky,[5] W. H. Stokes,[6] and others.

To the reported group of divergence-paralysis cases I wish to add another. This case is of interest because the clinical findings were those of a textbook case. In addition, the patient died shortly after the examination, and an autopsy was performed.

Case history: A white female, aged 28 years, stated that she had suddenly noticed double vision upon arising one morning and consulted an oculist. He gave her glasses which helped her distance vision, but aggravated the condition at the reading distance. She gave no other pertinent personal or family history. She recently had undergone a physical examination and was found to be in good health.

No gross external pathology was found. The pupillary reactions were normal, the media clear, and the fundus was normal in each eye.

The visual acuity was 6/6 uncorrected in each eye. There was a small refractive error under a cycloplegic. Uncrossed diplopia of 16 degrees was present at 6 m., decreasing above and increasing below the primary position of gaze. Laterally there was no perceivable change in the esotropia.

At 12″ fusion was present without a prism while at 4″ a crossed diplopia was found.

Monocular motility seemed unimpaired in each eye.

The fields of vision were essentially normal for white and colors in each eye.

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* The study of this case was made possible by the courtesy of Dr. M. N. Beigelman.

After repeated examinations did not alter the findings a diagnosis of divergence paralysis was made.

The patient was then examined by a competent neurologist and his only finding of abnormality was the conjugate paralysis.

The patient felt the interpretation of the findings was exaggerated, so sought care elsewhere.

Less than six months later the patient entered a hospital in coma of sudden onset and died without regaining consciousness.

An autopsy was performed and the findings were as follows: The floor of the third ventricle was dilated and of tissue-paper thinness. The convolutions were flattened between the lobes of the cerebellum and above the medulla was a cystic cavity measuring 4 cm. in its greatest diameter. This cyst had partly compressed the underlying medulla. The fourth ventricle aqueduct and the lateral ventricles were dilated to three times their normal size. No meningeal pathology was found, nor other brain-tissue change.

The cyst lay just left of the midline so that it compressed the adjacent left lobe of the cerebellum more than the right. Diagnosis: Cyst of the cerebellum with compression of the medulla and dilation of the ventricles.

Microscopically there were no signs of malignancy, and only pressure signs were present in the surrounding tissues.

The lesion was found between the lobes of the cerebellum just above the medulla and produced the conjugate paralysis by mechanical pressure rather than by infiltration. Much has been written in explaining and attempting to locate lesions producing this syndrome. The presence of a divergence center is questioned by some writers. Nevertheless, in the light of our present knowledge it seems the most tenable explanation of the syndrome.

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SOCIETY PROCEEDINGS

Edited by Dr. H. Rommel Hildreth

CHICAGO OPHTHALMOLOGICAL SOCIETY

February 19, 1940

Dr. Earle B. Fowler, *president*

Lawrence-Moon-Biedl syndrome

Dr. P. D. Shandeling said that this case was particularly interesting because there are evidences of this disease in other members of the family and because of consanguinity.

The patient is a man aged 21 years, of Jewish-Rumanian extraction, who was first seen in December, 1937, in the Department of Psychiatry because of abnormal social behavior, irritability, and withdrawal from activity. His mother states that he had never seemed to be normal mentally. His birth was not unusual. During childhood he developed rapid progressive loss of vision, so that he was "blind" by the age of 7 years. During five or six months before admission the patient developed hypersomnolence so that he was awake only five or six hours daily.

The patient's parents are first cousins and there is another instance of consanguinity in the family. The genealogy has been followed for four generations. The two instances of consanguinity consist of the marriage of first cousins in the parent's generation. The patient has a brother who is also blind but has no mental changes. Of the three offsprings of the other consanguineous marriage, two are deaf mutes and one has dementia praecox. The patient has in addition, two first cousins who also have Lawrence-Moon-Biedl syndrome, and they in turn have first cousins who have Lawrence-Moon-Biedl syndrome.

The patient's vision was reduced to light perception in each eye; no improvement was possible. There was no color perception. The central fixation was absent, and the vascular tree could not be elicited. Light projection was doubtful. There were constant searching movements of each eye. Aside from these there were no abnormalities externally. Each lens showed dense posterior subcapsular stellate opacities. Each fundus showed marked bone-corpuscle pigment deposits with advanced optic atrophy. Visual fields could not be taken.

The patient's general physical examination was essentially negative except for syndactylism of each foot. Neurologic examination was essentially negative. An encephalogram revealed moderate cerebral atrophy. The basal metabolic rate was −12. The blood cholesterol was 168 mg. percent. The blood and spinal Wassermann and Kahn tests were negative; there was a normal gold curve. The blood differential and urine were negative.

Hole in macula

Dr. T. M. Van Bergen said that F. Z., a man aged 19 years, entered the clinic on October 31, 1939, with blurred vision of the right eye. Vision had been perfectly normal until July, 1938, when a tire on which he was working blew out. He was not struck by the rim nor by any tool, but the right eye was blasted with 40 pounds of air pressure. He wore a patch over this eye for about a month because it was inflamed; has had no complaints nor other symptoms since then. The past history and family history were irrelevant.

Examination: Vision, R.E., unaided

= 0.2; L.E., unaided = 1.5. The left eye was normal. The right pupil was 7.0 mm. in size; the left, 6.0 mm. Both reacted to light and accommodation directly and consensually. The right eye otherwise was externally negative; its fundus was normal except that the macula presented a grayish black, oval area about two vein diameters across in greatest width. This was surrounded by a reddish ring.

Kuhnt-Junius macular degeneration

Dr. T. M. Van Bergen said that F. W. G., a man aged 59 years, entered the clinic on January 13, 1940, with complaint of failing vision in the right eye for the past six months; also burning and a frontal headache on overuse of the eyes in attempting to read. He had no other complaint. Past history and family history were not relevant.

Examination: Vision R.E., corrected, = 0.6; L.E., corrected, = 1.0. Both eyes externally were negative. The fundus examination showed some vitreous floaters in each eye. The discs were normal; the vessels showed moderate angiosclerotic changes. The retina of the right eye showed irregular, granular pigmentation between superior and inferior temporal arteries from the disc temporally to two disc diameters beyond the macula. The macula was raised, dark, with abnormal light reflexes. The retina of the left eye was normal except for dark granular pigment changes in the macula. The foveal reflex was normal. Bjerrum fields showed only a small absolute central scotoma in the right and a small relative scotoma in the left field.

Kayser-Fleischer ring

Dr. Frank C. Lutman said that J. S., a man aged 27 years, of Polish extraction, showed a hepato-lenticular degeneration of Wilson's disease. The interesting ocular findings were a loss of convergence power and Kayser-Fleischer rings.

Traumatic central chorioretinitis

Dr. Frank C. Lutman said that G. B., a boy aged eight years, had a traumatic central chorioretinitis in the right eye. He had been struck in the right eye in November, 1938, with a heavy weed. There was immediate decreased vision in the right eye. Two weeks after the accident, vision R.E., was 0.1 and there was a vertical linear area two vein diameters wide and 1.5 D.D. long in the macular region. Since then, the area has become heavily pigmented and areas of pigmentation and atrophy have appeared. Vision in the right eye now, aided, is 0.2.

Bilateral retinitis pigmentosa, optic atrophy, complicated cataracts

Dr. M. J. Fowler presented D. F., a man aged 51 years, who gave a history of having poor night vision. For the past 14 years he had been able to see only lights at night; he has been unable to read newspapers for the past 11 years. There was no similar history in other members of the family. Homatropine refraction showed corrected vision to be: R.E., 0.3; L.E., 0.1. Both lenses showed posterior subcapsular opacities; both discs showed atrophy, narrowed vessels, and, in the peripheries, diffuse bone-corpuscular pigment redistribution. In the macular area of the left eye a patch of chorioretinitic atrophy was seen. Bjerrum fields showed constriction total, to within three to five degrees of the macula. The diagnosis of bilateral nerve deafness was made four years ago.

High myopia, iris atrophy, and cataracts

Dr. Jerome A. Gans presented J. L., a man aged 18 years, who was first seen

on July 22, 1936, because of high myopia, greater in the right eye. Corrected vision was R.E., 0.3; L.E., 0.8+3. The lens of the right eye showed a few granular opacities and the discs showed temporal coni. Repeated refractions, hematologic, serologic, and metabolic studies gave no results. The patient was given vitamin D, but there was progressive increase in the myopia, iris atrophy, and cataract formation in each eye until on February 12, 1940, the vision in the right eye was light perception and projection only and in the left eye 0.5+1.

Grouped pigmentation of the retina

Dr. Jerome A. Gans said that L. C., a girl aged 12 years, was first seen on May 7, 1938, complaining of poor near and distance vision. Examination revealed a dense pigmentation halo about the discs, complete in the right, incomplete in the left eye, with marked grouped pigmentation in a ring 3 to 6 D.D. from the disc in each eye. The corrected vision was: R.E., 5/30; L.E., 0.6−3. No fusion was present, due to suppression of the image in the right eye. Tuberculin and Wassermann tests were negative. Lloyd fields showed a central scotoma in the right eye and an enlarged blind spot. On January 10, 1940, the vision was essentially the same.

A classification of vascular fundus diseases

Dr. S. R. Gifford and Dr. William MacPherson presented a paper on this subject.

Discussion. Dr. Sanford Gifford (closing) said that some of the patients with real papilledema are supposed to have encephalopathy with increased intracranial pressure. Apparently some do not, and the condition seems to be due to a marked ischemia. One cause of edema is the shutting-off of the blood supply entirely in such a way that it causes edema of the retina around the nerve. This classification is tentative, and it is hoped that cases can be placed into one of the groups satisfactorily; in other words, that certain pictures classified will fit into a certain group. But it is impossible to make all cases fit into any rigid classification.

The significance of accommodation and convergence in refraction

Dr. Philip A. Halper read a paper on this subject.

Discussion. Dr. T. D. Allen congratulated Dr. Halper upon his efforts. He thought that one point on which Dr. Halper might have spent some time was in relation to the examination of muscle balance at the near point. The important point is to test the muscle balance in the position in which the patient uses his eyes most: for distance, he uses the primary position; but at the near point, he uses the eyes in a depressed position. The eyes are directed downward about 20 or 25 degrees, and consequently the test should be made at that point. Small lateral imbalance is usually not very important. The vertical imbalance is more so. Imbalance may vary from day to day, from hour to hour, from room to room.

Convergence calisthenics is one of the really interesting contributions in orthoptics, and is of importance in patients with weak convergence; or in such cases prisms, base in, may be of help for those who will not or cannot take the calisthenics.

Dr. C. W. Hawley said that asthenopia sometimes is due to loss of nervous energy. Two instances might be cited: One patient complained of inability to read or sew. A second, a student, came in with a similar complaint about study work. The same error was found in each; but as the binocular vision was good, it was

thought there was no muscular imbalance in either. The student got immediate relief, but the other patient did not. This was later found to be due to her nervousness, and when she wore the glasses for a time, while under medical observation, she received relief.

Dr. Philip A. Halper (closing) said that in making muscle determinations routinely one not infrequently finds from a half to one diopter of vertical imbalance which may or may not be incorporated in the prescribed glasses. Such patients often have moderately large refractive errors, and the small vertical imbalances disappear when the correction for the ametropia is worn.

In answer to Dr. von der Heydt, concerning the amount of prism to be used for the correction of the vertical imbalance, a total of about three fourths of the full amount divided equally between both eyes—one half the amount being base down before the hyperphoric eye, the other half being base up before the hypophoric eye—seems to suffice. The majority of patients do show some exophoria. This is due to the receding accommodation in adult life with the resultant change in the convergence.

He did not agree with Dr. Allen as to the variations in the muscle determinations during an examination. Breaking the fusion against the pull of a muscle acts as an exercise for that muscle, and should the examination be prolonged so that many determinations are recorded, the patient is really subjecting his eyes to exercises. This will explain the variations in the muscle findings when several examiners check the patient repeatedly during the examination. In his experience, in examining the muscle balance and ductions in the same patient from year to year, relatively the same figures were found as at the first examination.

Regarding the amount of prism, base in, to be used for weak adduction, one will find that large prisms give the patient much trouble; a total of three diopters divided between both eyes is usually satisfactory. Why only a half diopter, base in, before each eye gives relief to the moderate exophoric with weak adduction one cannot say, but apparently it is so.

Robert von der Heydt.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

Section on Ophthalmology

February 15, 1940

Dr. Francis Heed Adler, *Chairman*

Aplasia of the optic nerve

Dr. Harold G. Scheie and Dr. A. M. Ornsteen presented a review of the literature on aplasia of the optic nerve. Complete aplasia of the optic nerve is due to failure of the mesodermal and ectodermal elements, giving no evidence of an optic papilla in the eye. Hypoplasia of the optic nerve in which central vessels are present in a very small, pale disc is due to failure of the ganglion-cell layer of the retina with resulting absence of nerve fibers in the optic nerve. A case of the latter was presented in a three-year-old boy, blind since birth.

Discussion: Dr. Mary Buchanan said that she had had one case in the previous year in which both eyes were affected. The discs were very small and gray, the vessels very narrow. The mother volunteered that in the sixth month of her pregnancy she had had uremia, and was admitted to the hospital for hypertension. The child, as in the case mentioned, was full-term and very bright. He is now at the Overbrook School for the Blind. Dr. Francis Heed Adler was of the opinion that if the aplasia of the disc in this

case had been due to failure of the ganglion cells to send fibers into the porous opticus, it should be possible with red-free illumination to detect absence of the fibers. This had been tried but was unsuccessful, due to the difficulty of examining without an anesthetic. Although no fibers were seen, the examination was unsatisfactory, and it cannot be stated definitely that fibers were absent.

Chorioretinitis of the Jensen type with secondary glaucoma

Dr. Thomas H. Cowan described a case of this type which will be published in this Journal.

Discussion: Dr. Walter I. Lillie said that Dr. Cowan's case presented two interesting clinical problems; namely, the question of whether (1) this was an early choroidal tumor, because of the localized elevated grayish-white area in the choroid just temporal and superior to the right optic disc without evidence of any associated inflammation. This was ruled out because of the precipitous onset of the symptoms, and the progressive course of the disease, with subsequent regression of all the inflammatory signs, except the permanent chorioretinal defect. (2) The final diagnosis should be Jensen's retinitis or posterior uveitis complicated with a secondary glaucoma.

When he had examined this young woman, the cornea was steamy and thick, and there were numerous discrete deposits on the posterior corneal surface. The pupil was contracted, and the media were so cloudy that a detailed view of the fundus was impossible. The intraocular tension was 72 mm. Hg. (Schiötz). He made a diagnosis of posterior uveitis with secondary glaucoma, and advised the use of atropine instead of miotics.

The subsequent course, as described by Dr. Cowan, substantiated this diagnosis, as in his experience a secondary glaucoma or a uveitis has never been associated with a Jensen's retinitis. Moreover, the final visual field defect was not continuous with the physiologic blind spot. These three findings: uveitis, secondary glaucoma, and the field defect, are much more typical of uveitis than of Jensen's retinitis.

Dr. Thomas Cowan said that the question of classification of various types of choroiditis is, of course, open to discussion. He does not consider this to be a true case of juxtapapillaris, but the definition of Jensen's disease is more or less an arbitrary thing. Later ophthalmologists say that it can be Jensen's disease only if the lesion is contiguous with the disc. Authors directly after the time of Jensen did not conform entirely with this definition and reported cases as belonging to the same category in which the lesion was far from the disc. Heath, the latest writer on the subject, thinks that all those cases in which the lesion is deep and extends far into the retina are related and can be considered typical of the same disease. Characteristically, it occurs in young persons under 35 years, usually intelligent, with no other signs of ill health until the ocular lesion occurs. Many cases of choroiditis of this and other types have been described in which secondary glaucoma occurred.

He would add that the only case of Jensen's retinochoroiditis on which a pathological report was made, that of Abraham, was one in which the eye was removed because the lesion was thought to be a tumor. The lesion might be considered a tumor, especially in those instances in which it presented some pigmentation in the early stages.

External exudative retinitis, Coats's disease

Dr. Willard G. Mengel spoke on this subject. He said the retinal involve-

ment is characterized by large masses of white or yellowish-white exudate beneath the retinal vessels, associated with cholesterin crystals. The onset is insidious and the etiology obscure. The affection occurs in young persons whose general health is excellent. Usually the condition is unilateral.

Two cases were reported. The first case was in a woman, aged 33 years. The right eye showed large, white areas with cholesterin crystals beneath the inferior temporal and nasal vessels, and also extending across the upper fundus beneath the retinal vessels. In this case the associated factors which might be responsible for the exudative retinitis were a sensitivity to tuberculosis and the effect of a miscarriage three months previous to the discovery of blurred vision, with the possibility of small emboli lodging in the retinal vessels.

In the second case, seen in a girl aged two years, the left eye showed a large white area with cholesterin crystals in the macular region, extending between superior and inferior temporal blood vessels, and laterally from nerve head to the far temporal periphery. The retinal vessels were clearly visible over the area and were not covered by exudate at any place. The associated factors in this case were repeated trauma, and the possible congenital nature of the condition—the result of bleeding in the mother during late pregnancy. These associated factors were present, but proofs of a direct connection with the exudative condition could not be made.

Discussion. Dr. Sidney L. Olsho showed the fields and retinal picture of a case of exudative retinitis reported in 1929, seen also by Dr. Heed. The family history seemed significant because it included cases of tuberculosis, disease of the nerve tissues, retinal disease, and blindness, with syphilis excluded.

R. G., aged 19 years, white, was in good health. His mother had died at the age of 36 years of an undiagnosed brain tumor. Two aunts and the maternal grandmother died of tuberculosis. The patient's father died at the age of 74, from a stroke. His sister, blind, died as a young adult. She was the mother of a child born blind who died in early infancy. Several children of a paternal uncle were lost early in life. The patient had two brothers and four sisters in good health. One sister, 15 years older, had poor vision due to retinitis pigmentosa discovered at the age of 9 years. Friends had noticed a peculiar bright gleam from the left eye of the patient about 7 months prior to his appearance, made in the hope of having the poor vision in the left eye remedied by glasses.

Physical examination and clinical laboratory findings were negative except as follows: Hemoglobin 76 percent with a normal red blood cell count and no leucocytosis; polynuclears 62; lymphocytes 35; mononuclears, eosinophiles, basophiles, each 1 percent. Coagulation time was 3 minutes.

Vision R.E. was 20/15 plus; L.E. 10/200 in a restricted field, but with color perception retained. Tension was normal. External appearances were normal except for a peculiar light gleam from the pupil of the left eye. The pupil reacted poorly to light and the consensual reflex left to right was poor.

The nerve head in this eye was hazy and poorly defined, except in its upper temporal margin. The lower three fourths of the fundus was seen as a homogeneous soft, yellowish-white, opaque surface raised almost uniformly about 1.5 D. Its borders extended from the margin of the disc upward and temporally and upward and nasally almost as far as the eye could see. The upper nasal border, at first straight, developed a num-

ber of undulations sharply defined from the nearly normal fundus above, and presented some ovoid collections and streaks of very soft gray pigment slightly below its superior limit.

The massive yellowish-white surface was quite uniformly of one color. A few very lustrous crystalline spots (cholesterin?) were seen in the lower temporal fields.

The retinal arteries and veins passed on to the yellowish-white area, and contrariwise, without showing any appreciable bends.

Far down and far out near the 5-o'clock region there was an increased number of good-sized venous and arterial branches, a number of which terminated with glomeruluslike coils. In one instance, there was an anastomosis of a small vein with an arterial branch. Fusiform swellings were also seen.

The yellowish-white surface beyond these vascular coils became billowy and projected several diopters forward in a number of rolls of retinal detachment in which the ultimate terminal vessels were lost.

Histopathology of secondary glaucoma

Dr. Wilfred E. Fry said that one of the most frequent specimens sent to the laboratory of pathology is an eye enucleated because of secondary glaucoma. The pathological material therefore available for the study of secondary glaucoma is large. Changes will occur in all parts of the eye. Certain lesions are ordinarily recognized as being frequently associated with secondary glaucoma.

In addition to changes of the eye that are induced by such conditions (shown in a slide) there may be one or more of the ocular changes that are recognized as being associated with increased intraocular tension. There are a large number of these, to two of which particular attention is called; namely, the sclerosis of the iris and ciliary-body arterioles, and the perivascular infiltration of the anterior ciliary vessels. Because of the great number of changes that eyes subjected to either primary or secondary glaucoma show, it is difficult to say which bear a causative relationship, and which are merely secondary to the diseased process. An examination of certain types of secondary glaucoma may be of use because the eye is frequently enucleated at a relatively early stage of the glaucomatous process instead of at a very late stage, as it usually is when an eye blinded from absolute glaucoma is removed. One of the early signs to which attention has been called is the perivascular infiltration that occurs about the anterior ciliary vessels.

A number of sections of eyes that were enucleated at the Universty of Pennsylvania were examined. It was possible in most cases to verify the statement of Evans. These slides were of various conditions, and were not limited to cases of intraocular tumor. One, however, was a case of melanosarcoma of the iris.

The glaucomatous globe may be compared to a sphere that is inflated under pressure. In order to have the pressure maintained in the sphere, not only must any large exit, which might be compared to the canal of Schlemm, be occluded, but the sphere must be of nonporous material. In the globe there are many small potential openings at the exit and entrance of vessels and nerves, which, according to the present examinations, are occluded by the infiltration of lymphocytes.

Discussion. Dr. Griffith said that he knew nothing about glaucoma. It would be rather a simple matter to block such perivascular spaces by injecting kaolin and see if animals develop what Dr. Fry would consider secondary glaucoma. We believe that a great deal more fluid is

absorbed by perivascular and perineural spaces in the central nervous system than is commonly believed. Because there are no quantitative ways of measuring the amount of absorption into the blood stream and into these spaces that occurs the general supposition has been that most of the absorption is by the blood vessels. We have methods for blocking "lymphatic absorption" or absorption into the perivascular and perineural spaces. We can perhaps find how important this is by investigating the damage done by blocking it.

THE SURGICAL TREATMENT OF ABDUCENS AND TROCHLEAR PALSIES

DR. GLEN GREGORY GIBSON read a paper on this subject, describing a number of selected cases of abducens and trochlear palsies that illustrate the various degrees of these conditions, and the type of operative correction that proved to be the most satisfactory in overcoming these muscular abnormalities. The importance of classifying the degree of both the subnormal rotational power of the palsied muscle and the excessive rotational ability of its direct antagonist was emphasized. The secondary rotational changes in the muscles of the nonpalsied eye were demonstrated to be of important surgical significance. The status of the sensory correspondence of the two eyes before the onset of the palsy was demonstrated to be of utmost importance in determining the ultimate outcome of the case. Binocular single vision may be hoped for in cases in which binocularity had been well established before the onset of the palsy and in which the surgical procedure is correctly applied to the abnormally acting muscles. Cosmetic improvement is the most that can be expected in those cases in which the palsy antecedes the development of binocular single vision. Bilateral recession of the interni, recession of the internus combined with the Himmelscheimer technique are recommended when the degree of the palsy and the rotational abnormalities warrant these various procedures in the various types of abducens palsies. In trochlear palsies, recession of the contralateral inferior rectus gives very satisfactory results in suitable cases. Occasionally the homolateral inferior oblique also may be tenotomized. Infrequently it may be necessary to operate on both the vertical and the horizontal motors at the same time. Encouraging results may be anticipated when the surgical procedure is applied according to the muscular abnormalities.

Discussion. Dr. Edmund B. Spaeth complimented Dr. Gibson and made some remarks on the tendon transplant for abducens palsy. The external rotation that is obtained is not the result of the tendon transplants themselves. The superior and inferior recti cannot develop any external rotation effect. The two transplants singly increase and augment the aponeurosis along the external rectus, holding the eye in such a position that the superior and inferior oblique, acting together, function as external rotators; that is, to give the abduction which occurs. He felt almost sure of this because he had seen a startling demonstration of it at the Graduate School in the muscle laboratory. There the various isolated palsies are studied as to the diplopia, the head tiltings that occur, and other phenomena by injecting the muscles of healthy individuals. In a case of tendon transplants with 18 to 20 degrees of external rotation the eye was injected along the line of the inferior oblique. The patient immediately lost, temporarily, all of the external rotation which he had had before the injection. So Dr. Spaeth was rather certain that the tendon transplants serve to hold the eye in that position to which the

cornea has been moved, by the resection of the external rectus and the recession of the internal rectus, and the two obliques together in this position of relative adbuction now permit further external rotation.

As to the mechanics of the surgical treatment of trochlear palsy: The approach can be either through surgery to the inferior oblique of the same eye, or to the inferior rectus of the opposite eye. The decision as to the choice for surgery is not so elastic. Bielschowsky, and White and Duane, separately, have presented indications and contraindications for these two procedures. In their opinion the tenotomy or the resection of the inferior rectus of the contralateral eye is indicated in those cases in which the lateral deviation is least outstanding, or one with esophoria or esotropia, and in those cases of trochlear palsy in which overaction is the greatest factor. Bielschowsky was very definite in outlining the surgery for this. He believed that the conjunctival recession should be in the depths of the culde-sac, a suture passed through the muscle mass, and this then detached from the sclera. One half of the suture is passed through the bulbar conjunctiva beneath the limbus, and then the patient is directed to look from eyes front to eyes laterally —for example, toward the contralateral direction—and the suture is tightened in that position until the two eyes are horizontally parallel. The tenotomy of the inferior oblique on the same side is to be carried out in those cases in which either an accompanying exophoria is present, or there is little if any torticollis, and little if any overaction of the contralateral synergist. White considers the tenotomy of the inferior oblique to be an unsatisfactory procedure, and to be done as an operation secondary to that of inferior rectus surgery on the contralateral side; never as a primary procedure.

Warren S. Reese, *Clerk.*

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

February 5, 1940

Dr. Arthur M. Yudkin, *presiding*

Unusual lens changes following trauma

Dr. Daniel M. Rolett after giving the history of the injury stated that in his opinion the characteristic changes in the lens of young people, following trauma were: (a) peculiar cobweb opacity occupying the superficial central layers of the lens, (b) evidence of an accompanying iridocyclitis, (c) stationary, nonprogressive character of the cataract, and (d) occurrence in juveniles.

According to Dr. Rolett the trauma to the ciliary body and iris results in an extravasation of exudate which adheres firmly to the anterior or posterior lens surface. There it forms an impermeable membrane which eventually interferes with the nutrition of the lens, leading to formation of a localized cataract. To prevent such cataracts, the author advises early and repeated punctures of the anterior chamber, to increase the flow of aqueous to facilitate removal or prevent adherence of the exudate to the lens.

Discussion. Dr. Milton Berliner thought it was unfortunate that Dr. Rolett did not show the optical section of the lens so as to show how the membrane affected the interior of the lens. He said he had two pictures showing anterior-lens capsule with one floating in the anterior chamber, following iritis. He did not quite understand about the change inside the lens. Was this membrane connected to some type of subcapsular change? Viewing such an opacity, one can get a shadow frequently that will not only give apparent change in the curvature of the lens but that may appear as a secondary membrane.

Dr. Morris Davidson said that in about 60 percent of lens contusions there are subcapsular lens opacities. From the description and the pictures shown the opacities in this case are intralenticular. The pigment dots look like a posterior Vossius ring occasionally observed. In general, opacities do not require explanation in terms of exudate. Experimentation has shown that in contusions there is a temporary subluxation of the lens, during which considerable damage is done to the lens by the ciliary body against which it presses. This crushing of the ciliary body is also found in every case of contusion.

Dr. Rolett said that the optical section was not shown because there was little to show. The capsule, the subcapsular layer, and the first disjunction band were involved on both the anterior and posterior surfaces. There was no evidence of subluxation when first seen on the third day. There was no pigment in the vitreous.

Hypertelorism

Drs. Milton L. Berliner and Samuel Gartner stated that this is a congenital anomaly of the skull and face characterized by a wide separation of the orbits. The first cases were described by Grieg in 1924. He found the lesser wings of the sphenoid greatly enlarged and believed this to be the basis of the anomaly. He named the condition ocular hypertelorism, from the Greek meaning too far apart.

A case of hypertelorism was presented in a woman, aged 31 years, who was born with this defect. The interpupillary distance was 84 mm. There was a right divergent squint of 140 prism diopters. There was pallor of the right disc with concentric field contraction and a relative central scotoma. X rays showed the anomalous arrangement of the orbits, narrowing and distortion of the optic canals.

Discussion. Dr. Morris Davidson said he did not see what difference an unusually large interpupillary distance would have on binocular vision as long as the two eyes can converge.

Dr. Samuel Gartner said he had no figures on the effect of unusual interpupillary distances on binocular vision. All papers on this subject mention a divergent strabismus or illustrations show it. He wondered whether the wide interpupillary distance necessitated a divergence strabismus.

Transitory myopia following sulfanilamide therapy

Dr. John Bailey presented the case of a 25-year-old white man who had been treated with sulfanilamide several days prior to consulting him and who suddenly noted marked visual blurring. All the findings were normal and vision was improved to 20/20 in each eye with a −3.00 diopter lens. This was not a case of ciliary spasm because homatropine had no effect on it. On the fourth day the vision had returned to normal.

Discussion. Dr. J. I. Pascal stated that there is good clinical and pharmacological evidence to support the contention that the ciliary muscle consists of two portions separately innervated by the sympathetic and parasympathetic. A temporary overtonicity of the parasympathetic may explain such transient myopia. As another possibility, had the speaker ever run across a theory that transient myopia may be caused by a slackening of the zonular fibers attached to the anterior capsule of the lens? Such a slackening may be caused by some transient local condition such as edema, general weakness, or some systemic disease. When this condition passes, the tension of the zonular fibers is regained and the myopia disappears.

Dr. Benjamin Esterman said that he had a similar case about the same time in which the patient had been getting 20 gr. of sulfanilamide daily for the past two weeks. In addition to the myopia he had edema of the lids and conjunctiva. In this case homatropine was successful in reducing the myopia, which cleared up permanently in three days.

Dr. J. Landesberg reported a similar case treated with 90 gr. of sulfanilamide daily for a corneal ulcer. The myopia was −3.00 diopters in each eye improvable to 20/20 with lenses. It passed off when the therapy was discontinued. Hysteria can be ruled out when one can improve the vision to 20/20.

Dr. Adolph Posner said that he had seen Dr. Esterman's case and that it was remarkable that neither atropine nor homatropine produced complete cycloplegia until the sulfanilamide had been discontinued.

Dr. Joseph Igersheimer said that in his experience transitory myopia occurs mostly in young persons and this indicates a condition produced in the lens.

Dr. John Bailey said that it is permissible to give large doses of sulfanilamide to produce 5 to 10 mg. per c.c. in the blood. He did not consider hysteria in his case because there were no other symptoms of hysteria. There is a good deal of truth in the theory of edema of the ciliary body causing transitory myopia. Elschnig claimed that there is hyperemia of the ciliary body, and the circumlental space is encroached upon. The lens will become more curved just as it does in the process of accommodation. Exact optical investigation shows that the condition is in the lens itself; that the increase of the refractive index of the nucleus is enough to produce a high amount of myopia particularly as the cortex is not involved. The change in refraction depends on the relative changes in the cortex and nucleus.

The theory of double ciliary innervation is ingenious but impractical. This means two accommodative muscles, one for near and one for distance. Of what use is it to make an ametropic eye more hypermetropic? If there is a myopia of nine diopters due to paralysis this means the muscle can produce a hypermetropia of nine diopters for distance. This condition appears in the young and in the old.

Stevens-Johnson disease with visual recovery

Dr. Isadore Givner reported the case of a 23-year-old white man with erythema multiforme involving the face, forearms, extensor surfaces of the arms and legs, chest, and back, as well as the mouth, throat, and eyes. There was a pseudomembrane of the conjunctiva but no corneal involvement. The patient recovered with no visual impairment.

Discussion. Dr. H. Ageloff said he saw a similar case at the Lincoln Hospital, thought to be measles. The lids were covered with exudate and could not be pried apart. The skin over the body peeled away at the touch. Vigorous antiseptic irrigation of the lids and conjunctival sac was successful in saving the vision with no impairment.

Dr. S. Morse reported a similar case, diagnosed as measles, with a thick membrane of the conjunctiva which looked diphtheritic. This membrane cleared up with antidiphtheritic therapy. If nonspecific therapy is used the results are just as good.

Dr. John Bailey congratulated Dr. Givner on his results. He said that these cases all improve under sulfanilamide therapy, and that we are justified in attributing the result to this drug. Whether it is specific for this or that bacteria is not important.

Dr. E. Waldstein asked how one could be sure that this was a case of erythema multiforme and not pemphigus, since he had never seen a case of erythema multi-

forme with eye involvement.

Dr. Isadore Givner said that to differentiate these two we have the Nikolsky sign. It is true that eye lesions are rare here.

Choroidal tumor presenting unusual histologic findings

Drs. Benjamin Friedman and Ludwig Sallman presented the above case.

Discussion. Dr. Morris Davidson said that this case showed that the fovea may be seriously underfunctioning and yet show no physical ophthalmoscopic changes to account for it.

Dr. Benjamin Friedman said that once the tumor made itself evident there was no need for transillumination, because the diagnosis was simple. In looking back at the case it might have been possible to diagnose the tumor earlier, but there is no question that the subretinal fluid brought about visual-field changes long before the ophthalmoscopic appearance gave any evidence.

A method of diplopia-charting in ocular paralysis

Dr. Adolph Posner reported a case of paralysis of the left inferior rectus with recovery by an initial conversion of a part of the manifest deviation into a latent deviation. Finally this also disappeared and normal binocular vision was restored. By latent deviation is meant a deviation which may be overcome by moving the head or the fixation point from a region of binocular single vision into the region of double vision. The perimeter affords a simple means of accurately plotting the extent of the diplopia field. If the deviation is small a tangent screen or similar device may be used to advantage. By this method the latent phase of the deviation, which is an important index of the degree of functional recovery, may be accurately measured. The method is physiologically sound, based as it is on the patient's own instinctively adopted device for overcoming his diplopia. Although the fusion mechanism undoubtedly plays a part in overcoming latent deviation, it is hard to say whether it plays an exclusive role.

Discussion. Dr. J. I. Pascal said that the marked difference in adduction power in the two ways of making the test in this case may be due to the development of a false-projection area in the deviating eye. In cases of squint the deviating eye sometimes develops a fairly large, more or less variable, area on its retina where the image of the object of attention is projected to the same place as is the image of the good eye, thus producing the effect of single binocular vision. The size of this area varies and depends upon the end from which the false image is brought into this region. When we start with superposed projection—that is, with single vision—this area of false projection covers a much larger region of the retina, showing much higher duction power than when we start with seeing double and bring the false image into this area until there is superposed projection.

Dr. Percy Fridenberg said that this principle of Dr. Posner's about distinguishing the latent phase was interesting because of the analogy between the findings here and the familiar findings one gets when starting from a functioning area to a nonfunctioning one. In this manner one gets a larger circumference than in going the other way.

Dr. Sigmund A. Agatston said that this phenomenon should be explained on the basis of fusion. A patient like this one, recovering from paresis, if allowed to fuse in a position of binocular single vision, will hold the eye in a central position due to the effort of fusion.

Dr. Morris Davidson said that cases of ophthalmoplegia were excellent material for studying this zone of hetero-

tropia. There is a stage of heterophoria following the process of recovery from heterotropia. Whether this depends on the different size of the retinal fusion area or on a different response of nerve and muscle fibers involved is hard to say. Whether there is really diplopia can be easily ascertained by a performance test which will determine the presence of binocular single vision. This phenomenon is seen in traumatic ophthalmoplegias. Where the opposite occurs, it is interesting to observe the frequency of suppression in the field of increasing diplopia or increasing heterotropia. As the contracture grows the heterotropic field grows. A performance test will always determine whether a person has suppression or binocular single vision in the particular field under investigation.

Dr. E. Krimsky said that in testing for convergence one will find that in bringing the test object closer to the eye than the convergence near point the patient will see single, whereas with a small light he will have diplopia. The variation in Dr. Posner's case is quite analogous to what one gets with a breaking point and recovery point in testing for abduction range.

Dr. B. S. Kramer said that the only way to explain this case is by alternating fixation. When the object is brought from below up, the patient fixates with the right eye; when from above down, with the left eye.

Dr. Adolph Posner said that the patient was an engineer who was very accurate in his observations and that he was looking at the test object with an area very close to his fovea, the light reflex being in the center of the pupil. He could describe the position of the false image accurately. This is not a question of functioning and nonfunctioning areas; both areas are functioning. It is a matter of diplopia or single-vision areas. He believed that the patient was not suppressing.

Clinico-pathological study of diabetic retinitis

Dr. Sigmund A. Agatston discussed this subject and showed by slides that while the small hemorrhages of diabetic retinitis were caused by capillaries, the larger hemorrhages were due to thrombosis of the retinal veins. He stated that while hyperglycemia may be responsible for metabolic changes in the arterial walls the effect is even more specific on capillaries and veins.

Xeroderma pigmentosum with ocular complications

Dr. John Reinhorn presented a case of eight years' duration in a young negro child of mixed breed with the typical pigmentary dyscrasia, multiple carcinomata, and involvement of the lids and corneae of both eyes with left ocular phthisis. This is one of the few cases reported in a colored child.

Sidney A. Fox,
Secretary.

ROYAL SOCIETY OF MEDICINE

Section of ophthalmology and Section of neurology

February 22, 1940

Mr. Malcolm Hepburn, *chairman*

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Symposium on tumors of the optic nerve

Mr. A. C. Hudson said the total number of recorded cases of primary tumors

of the optic nerve and chiasma is less than 350. Most of the tumors can be classified histologically according to their origin in the glial tissue of the nerve, or in the tissues of the nerve sheath. The great majority of the sheath tumors are meningoendothelial.

The glial tumors occurred in the series in the proportion of 3 to 1 meningeal. Both types of tumor are rather commoner in the female than in the male. There is a striking difference in age-incidence; 40 percent of the glial tumors caused symptoms during the first five years of life, but not one meningeal; 60 percent of the glial tumors came to notice in the first decade, as against 24 percent of the meningeal; and 90 percent glial as against 50 percent meningeal in the first two decades.

Both types of tumor, when intraorbital, cause exophthalmos, usually very slowly progressive. The direction of the exophthalmos is most commonly straight forward; but sometimes it may be downward and outward, especially in the case of large tumors. Exophthalmos has been associated with pain in some of the meningeal tumors, and with slowly increasing hypermetropia in one case of each type of tumor.

Movements of the eyeball are often little or not at all affected by a glial tumor, a point first noticed by Graefe as indicative of freedom from tumor formation of the most anterior part of the nerve. Limitation of movement in the case of meningeal tumors, on the other hand, is common, and may be complete in advanced cases, the eyeball being fixed to the cuplike anterior surface of the tumor.

Progressive defect of vision or amaurosis of the prominent eye is almost invariably found with both types of tumor. It has preceded exophthalmos in many cases of glial tumor, in one case by as much as 24 hours. In the case of meningeal tumors, on the other hand, the failure of vision is usually explicable as being the direct result of pressure of the tumor. Amaurosis or defective vision with hemianopic field in the prominent eye, associated with the hemianopic field, and usually defective central vision, in the other, is evidence of extension of a glial tumor to the chiasma; a similar affection without exophthalmos is met with in cases in which the intracranial portion of the nerve and the chiasma are affected.

Ophthalmoscopic examination usually reveals optic atrophy or, less commonly, papilledema. In two cases extension of a glial tumor to the nerve head has been discovered with the ophthalmoscope, and in two cases it has been found *post mortem*. In view of the fact that meningeal tumors not infrequently extend through the sclerotic to the choroid it is remarkable that no corresponding fundus change has been noted.

X-ray studies may show the shadow of an intraorbital tumor. Extension of a glial tumor backward beyond the apex of the orbit is frequently indicated by enlargement of the optic foramen. Martin and Cushing have pointed out that, with glial tumors of the chiasma and intracranial portion of the optic nerves, the sella turcica may have a gourd-shaped outline, attributable to enlargement of the optic foramina and forward extension of the sella under the anterior clinoid processes.

Prognosis: As regards the glial tumors, it is a remarkable fact that, in spite of the high percentage of cases in which removal of an orbital tumor has been complete, in only one case (Seefelder, 1931) has a recurrence of the tumor in the orbit been recorded, while subjects of incomplete operation have been found free from recurrence 10½ and 20 years later. In other cases there has been no recurrence 15, 18½, 19, and 24 years (two cases) after operation.

Meningeal tumors recurred in 15 percent of cases, at periods from two months to 25 years after operation. The tumor recurring after two months was removed, and had not recurred again after two years, while another tumor, which recurred after seven months, and was removed, recurred again after nine years. A liability to recurrence is not surprising when it is borne in mind that these tumors have not infrequently been found to have invaded neighboring structures, six times the sclerotic and the choroid, three times muscle, and once the optic-nerve head.

As to expectation of life, the data available were too scanty to be of much value, except in so far as they indicate the gravity of signs of involvement of the chiasma by a glial tumor. In all of the 13 cases in which death occurred under observation (at periods of one month to four years after the patient first came under notice) and in the three cases in which it occurred immediately after operation there were symptoms of chiasmal or other intracranial disease.

Many years ago he had suggested that certain peculiar features in cases of glial-tumor history of defective sight before the appearance of signs of tumor, often of many years' standing, and sometimes dating from the first few months of life; absence of recurrence of tumor in the orbit after incomplete removal, and the ill-defined transition of the tumor tissue through tissue showing neurological proliferation into normal tissue, in spite of the absence of malignant characteristics, might be explained on the supposition that the tumors were manifestations of an overgrowth of neuroglia in tissues which had previously been exposed to some deleterious influence, and were therefore not true neoplasms, but manifestations of a degenerative gliomatosis.

Verhoeff, in 1932, expressed the opinion that the tumors were true gliomas composed of cells derived from astrocytes; at the same time he made the following comment: "It may be of considerable practical importance that within the nerve-stem the growth does not advance by invading the original structure, but by causing the pre-existing neuroglia in the vicinity of the tumor to proliferate and take on the character of the tumor tissue. This would seem to indicate that some substance is produced by the tumor which stimulates the contiguous neuroglia. The possible practical importance of this observation lies in its indication that removal of the largest part of the tumor may do away with the assumed stimulating substance, and thus prevent further extension of the growth." It appears to him that this conception would place the tumors in quite a different category from the neoplasms.

The histological researches of Lundberg, inspired by the pioneer work of Del Rio Hortega, and reported in 1935, in a valuable monograph, showed that of the nine glial tumors examined all were oligodendrocytomas. No indication is given that he regarded the tumors otherwise than as true neoplasms arising in previously healthy tissue.

The evidence as to the relationship of Recklinghausen's disease and glial tumor of the optic nerve and chiasma, which was first adduced by Goldmann in 1893, has since then been strongly reinforced by the discovery of a considerable number of cases in which both affections were manifested in the same individual. An association of meningeal tumor with neurofibromatosis has also been met with in a few cases. A conception of glial-tumor formation as analogous to the phenomenon in neurofibromatosis of a true neoplasm arising in previously abnormal tissue would accord with the clinical picture.

DR. DEL RIO HORTEGA said that his paper deals with those tumors of the optic

nerve which develop in their own parenchyma and derive from their own cells. The tumors arising in the nerve sheaths, those which infiltrate the optic nerve from adjacent structures, for example, the retina, and metastatic tumors are excluded.

The old classification as sarcomas, myxosarcomas, and gliosarcomas has been abandoned. The modern denominations of polar spongioblastomas and schwannoid oligodendrocytomas are not yet definite.

These tumors are certainly gliomas, similar to the cerebral gliomas, but they have a special picture. They are formed by very elongated cells arranged in bundles and plexuses. These cells are commonly bipolar, but they may have three and more processes although this astrocytic type is very rare. Among them are often small rounded cells similar to oligodendrocytes.

The interpretation of these cells is rather difficult. They could be considered atypical astroblasts, since among them there are some astrocytes which may indicate a progress in the differentiation. They could be interpreted, too, as atypical schwannoid oligodendrocytes, since among them there are other types of oligodendrocytes. But it is impossible to interpret them as polar spongioblasts without providing an artificial solution for a problem that is not yet solved.

Therefore, the denomination of these tumors may be longicellular astroblastoma, or schwannoid oligodendrocytoma. Their cells have no spongioblastic characters. They are elements in a degree of differentiation corresponding to the astroblasts and astrocytes, but morphologically they are more similar to the schwannoid oligodendrocytes.

From the differentiation of their cells it is possible to conclude that tumors of the optic nerve belong to a group comprising: (1) Tumors of the optic nerve. (2) Tumors of the optic chiasm. (3) Many tumors of the corpus callosum. (4) Many tumors of the medulla oblongata. (5) Cerebellar astrocytoma.

These tumors are morphologically linked without interruption. All these tumors have abundant bipolar, elongated cells, associated with more or less abundant astrocytes poor in processes. Clinically they all have a moderate malignancy.

MR. E. WOLFF said that Hudson (1912) in his classical paper was the first to raise his voice in protest against the usual classification of these tumors into intra- and extradural. Verhoeff (1922) in an admirable contribution entitled "Primary intraneural tumors (gliomas) of the optic nerve" gave further evidence why the above method of describing these growths would not do. His contribution today will be mainly to point out certain aspects of the pathological anatomy of these tumors and to try to show how this determines their method of spread. In order to do this he had found it indispensable to compare them with their intracranial counterparts.

According to MacCallum (1936) gliomata of the brain are rarely sharply outlined either by their color or their consistence, but shade off insensibly into the surrounding brain substance. Their position can be made out in the cut surface fairly well, however, by the swelling, the increased vascularity and translucence, and by the hemorrhages and necroses which are usually present. There are some forms, indeed, which are so diffused through the brain substance that it is difficult to determine their outline even with a microscope. Gliomata do not, as a rule, extend to the surface of the brain and never pierce the meninges.

Under the microscope most gliomata present a fairly uniform mass of cells rather small in size with numerous proto-

plastic processes which join in a tangle with those of other cells and thus produce a network of delicate filaments. Great variety is seen in the form and arrangement of these cells. They are frequently found to have a rather abundant cytoplasm with many long processes extending in all directions so that they have acquired the name of astrocyte or spider cell. Others are much simpler in outline and have very few prolongations. In many gliomata they are especially condensed around the blood vessels, in others there are minute spaces about which cells are arranged radially with a flat or curved foot at the edge of the space and a long frayed-out cell body extending peripherally to become entangled with the other cells.

Degenerative changes, hemorrhages, and necroses are frequent in these tumors. They may lead to such widespread destruction of the tumor that only a thin rim of the tumor tissue is left. It is not infrequent in such cases to find that the débris of the tumor cells and blood has been replaced by a clear fluid, so that the whole area appears as a thin-walled cyst with only some pigment and traces of tumor tissue in its walls to indicate its original nature.

Trotter (1918) states that the glioma is a true tumor of the brain substance and possibly the only one. Cushing and his associates have shown that the differentiation between glioma and sarcoma may be extremely difficult and that the more thorough the histological examination the fewer appear to be cases of true primary sarcoma of the brain. There are also general grounds for supposing that true sarcoma is unlikely to arise in the brain substance. It may certainly be said that glioma must be regarded as the classical brain-substance tumor and that cases of supposed sarcoma should be regarded with caution.

A striking characteristic of all gliomas is their very slight tendency to invade nonneural tissue.

Dural endothelioma spreads on both aspects of the dura. Internally it presses on the brain in which it may make a large and deep impression but without, until the latest stages, becoming fixed to the brain substance.

The changes described are exactly like those that occur in the optic-nerve tumors. It thus becomes clear that since the optic nerve is no nerve at all but a part of the brain its tumors will be, in all essential features, identical with those of the brain, and just as there is really only one brain tumor, the glioma, so there is only one intraneural tumor of the optic nerve—also the glioma. The endothelioma in both cases is a tumor of the meninges.

The differences in the manner of growth between the intracranial glioma and endothelioma and those of the optic nerve are due to anatomical differences and especially to the arrangement of the nonneural tissues. The glioma of the optic nerve usually starts some 10 mm. behind the globe in the region where the arteria centralis enters, and he believes it extremely likely that the profound changes that take place when the mesodermal central artery is enclosed in the backward extension of the choroidal cleft may have an important bearing on this site of election for the origin of these tumors. From this point the tumor tends to grow toward the brain, so that the part between it and the eye tends to be free from growth. The reason for this is that, as stated before, the growth has little tendency to invade nonneural tissues, for anteriorly we have the arteria centralis with its connective tissue sheath and also the much denser septa present in this anterior part of the nerve. These naturally do not form an absolute barrier, for occasionally cases have been reported where the growth has

reached the papilla.

The next point that calls for explanation is the presence of the growth in the subarachnoid space. Why does it get through the pia and not through the dura, which is made of the same tissue? The answer appears to lie in the fact that hundreds of processes, the septa, pass from the pia into the nerve, and also in the structure of the septa themselves. A cross section of the optic nerve reveals that a number of the connective-tissue septa are "incomplete," and it is probable that the growth gets into the septa at these gaps. The growth separates the constituent fibrils of the septa and so produces a characteristic appearance; in a low-power view of a cross section of the nerve at an early stage of the growth it does not appear grossly altered. The septa merely appear widened, as do the enclosed spaces between them. Proceeding peripherally along the septa, the growth reaches the pia whose constituent fibrillae are also separated by the growth. The pia, however, although widened by the tumor, can usually be made out separating the intra- and extrapial portions of the growth.

As stated before the growth does not get outside the dura, and this has an important bearing on the difference between the clinical features of the glioma and the endothelioma.

The dural endothelioma of the optic nerve, like that of the central nervous system, spreads on both sides of the dura. Internally it will press on the optic nerve, which may be compressed to a thread but is not invaded by the growth except, perhaps, at the latest stages. Externally, not being in contact with bone, it does not induce those remarkable changes in the walls of the orbit so characteristic of the changes produced in the skull by the intracranial dural endothelioma. In fact it grows freely in the orbit till, eventually, it will have the shape of the muscular cone. Anteriorly it grows round the back of the globe, pressing on it and causing an artificial hypermetropia. Also it will eventually form a cup for the back of the eye and, continuing its growth forward, may be palpated through the eyelids. Incidentally, the endothelioma is much more likely to interfere with the ciliary vessels and so produce those pigmentary changes in the fundus (as shown in a case of Sir John Parsons and published by Neame and himself, 1925) which Wagenmann and others have described after cutting these vessels experimentally in the rabbit.

Intraocular extension is rare both in glioma and endothelioma. But in the former the spread is along the optic nerve to the papilla, while in the latter it is through a canal for a posterior ciliary artery or nerve, so that the swelling inside the eye resulting from the tumor is peripapillary. The swelling of the disc that so often accompanies endothelioma of the optic nerve is, therefore, not due to the intraocular extension of the growth, as it may be in the glioma, but to a papilledema, the result of interference with the venous or lymph drainage.

Professor Geoffrey Jefferson said that neither in the case of meningeal tumors nor in that of intrinsic glial tumors of the optic nerve could one say that the intraorbital portion was the only part involved by the tumor. One spoke of meningioma of the optic sheath: surely such a tumor might be expected to be found only where that sheath existed—that is, within the orbit—and in the main that is true. On the other hand, a meningioma centered on the anterior clinoid process or about the sphenoidal wing might seed itself into the optic sheath and produce there the effect of a sheath meningioma. Thus there might always be a doubt concerning a sheath meningioma as an isolated process. It might be part

of a larger, perhaps undisclosed, tumor, and this might be the explanation if a case ran a course of an unfavorable character. The link would be with the meningioma *en plaque* and of the sphenoidal wing, but although he had seen and operated on several patients in such cases, he had not had the opportunity of verifying the state of the optic sheath in any.

He had had more than one discussion on optic-sheath tumors with Harvey Cushing, who was extremely reluctant to accept the view that a sheath meningioma did exist as a perfectly individual tumor. He showed an example of one of these meningiomas *en plaque* to illustrate the unroofing of the optic canal in the hope of saving the vision in the affected eye. He showed it for two purposes: first, as an example of the type of change he was talking about, and, secondly, as illustrating the transfrontal approach to the orbit through its roof. The roof had been cut away and carried back so as to uncover the optic nerve. The X-ray picture of the optic-nerve canal beforehand did not show any great thickening, and it seemed likely that what had happened was that the tumor had actually invaded the sheath. He showed it also because it illustrated the neurosurgeon's approach to the orbit, which he thought very much superior to the external approach, not only from the point of view of cosmetic result, but because the view and the actual approach to the tumor were better, and it was, moreover, a relatively simple operation which carried no mortality.

His next case was an example of what seemed, at present at all events, to be a pure sheath tumor. This was in a young man, aged 23 years, who had suffered increasing loss of sight in the right eye, and had slight external strabismus and exophthalmos. The vision in his left eye was normal, and his fields were normal. The eye had that elastic feel which was rather characteristic of tumors of the optic nerve which increased the mass of the nerve and produced protrusion in a perfectly mechanical way, quite apart from any other structure or engorgement or anything else in the orbit.

The eye in this case was excised, and he discovered what an unsatisfactory method of approach the transpalpebral or ordinary frontal approach to the orbit really was. Until the eyeball had been removed one could not tell what might be lying behind it, and it was impossible to get far enough back towards the optic foramen to make a really good removal. In this case the excision of the affected nerve surgically and pathologically left much to be desired. The tumor was a sheath meningioma of the optic nerve, and in spite of the incompleteness of the removal there had been no sign of recurrence during the five years since the eye was excised, a fact which bore out what Mr. Hudson had said about the long life of some of the meningiomas. This was one of the cases that was followed by radiography during the whole time to see whether or not there was any indication of extension of the process backward, a development undoubtedly more common in gliomatous tumors of the nerve than in sheath meningiomas, because the gliomas more definitely passed through the optic canal than did the sheath meningiomas.

The remaining cases of this series—of which there were seven—were gliomas of the optic nerve and the optic chiasma. He asked his colleagues at the Royal Eye Hospital at Manchester to look up their records and this had made possible the study of another nine cases of optic-nerve tumor, about half of them in children. From what Dr. del Rio Hortega had told them, it was quite clear that there was nothing really specific about the tumor of

the optic nerve. He had shown the sort of polymorphism of the optic glioma that was shaded out over a background of similarity. The tumor was always the same thing, although it might have a considerable difference of appearance. It could be duplicated in the brain-stem, the pons, and the corpus callosum.

These facts were borne out by the clinical cases. The first was the case of a girl, aged 12 years, who was admitted to the Manchester Royal Infirmary on the medical side because she had had a fit and had fallen into the fire and burnt her hand. But in addition some weakness had been observed down the left side of her body. She was at that time an ill child. She had developed a squint at the age of 18 months. Mr. Hudson had already mentioned at what an early age these troubles might begin. At the age of five she was seen by an ophthalmologist who said she was blind in her right eye. The left eye at that time was normal. She went on from then to be perfectly well, went to school and was always at the top of her class, until she approached the age of 12 years, when she began to suffer from headaches, and this weakness down the left side of her body developed. A photograph of her hands showed a certain wormlike movement of the left hand, and this made the diagnosis of increasing interest. An X-ray view of the skull showed the undercutting of the anterior clinoid process from the sella turcica. The sella turcica was practically obliterated, and there was a "gourd-like" extension below the anterior clinoid process, which Cushing and Martin thought might be very characteristic of optic glioma. The optic foramen was more than double the size it should be.

Here then was the problem: A child of 12 years, lately suffering from fits and severe headaches; on examination an atrophic disc in the right eye, a choked disc in the left eye, with some atrophy behind it, also some numbness on the left side, and X-ray evidence of enlarged sella and enlarged optic canal. The diagnosis was a tumor of the right optic nerve extending into the chiasm, and it seemed to be certain that the origin must extend into the subthalamic region and involve the nucleus subthalamicum. That proved to be the case.

The next case was that of a boy, aged nine years, who had proptosis of the right eye and typical stigmata of von Recklinghausen's disease. He had actually under his skin here and there small subcutaneous neuromata. He showed one illustration of this case in order to demonstrate that the changes of the chiasms did not necessarily reflect themselves in the way that might be imagined in the sella even when there was a massive tumor. He had hoped that it might be possible in this case to cut the nerve intracranially, but the involvement of the chiasm made that impossible. The case showed that even with a tumor of this size it was not inevitable to get any great changes in the sella itself. The tumor was a glioma.

The case following furnished rather a lesson in diagnosis. A boy, aged 12 years, had complained for some years of failing vision in both eyes. He had no signs whatever of von Recklinghausen's disease. The story was one of visual failure. He had bilateral optic failure and an open sella turcica with no great depression of its floor. The cause of the visual failure seemed very doubtful. For the previous five years his sight had remained about the same, and then began to get rather worse. A ventriculogram showed relatively small ventricules and quite evidently a large tumor of the optic chiasm. At operation a firm white tumor was discovered which was at first thought to overlie the optic nerve and chiasma, and preparations were made to remove it by

dissection, under the impression that as it became reduced in size the optic nerves would come into view. However, after the preliminary steps had been taken it was seen that the tumor was actually in the optic chiasma, and not just pre-fixed to it but extending into the optic nerve, and he was only just prevented in time from undertaking a removal which would have left no optic apparatus at all. The effect of the biopsy was not to depress the vision very much, and five years afterwards, although his vision was not by any means good, he was still able to get about. There had been a gradual deterioration, but the case again showed the extraordinary malignant attenuation of these tumors. They are fascinating cases both clinically and pathologically. Now that their nature is known, even the biopsy which he had made in this case was an unnecessary step. He would not say that one was always certain without an operation that the patient, unless he had von Recklinghausen's disease, had a glioma of the optic nerve or chiasm. But from experience with these cases he thought they could rest assured that the pathological process extended so far inward into the actual structure of the chiasm and optic nerve that it was extremely unlikely one could do the patient any good by operation, and one might easily be tempted to an intervention which would do harm. The only occasion on which good might be done was when the tumor was localized in the intraorbital portion of the nerve.

The other cases in this series which he might have shown would have done no more than confirm the two or three cases which he had already described.

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THE VISUAL ZONE

With the pupil dilated by a cycloplegic, different parts of the pupil show different states of refraction. Puzzled by this, many ophthalmologists come to disregard skiascopy in measuring refraction. But it is the most accurate objective method of measuring refraction, if attention is concentrated on one part of the pupil that it is important to correct by glasses—the visual zone. The fully dilated pupil is eight millimeters, or more, in diameter. Through this dilated pupil four times as much light will enter, or come out of, the eye as can come through the visual pupil, four millimeters, or less, in diameter. It is through the visual zone that light enters the eye, when vision is used in outdoor daylight, or with convergence for near work.

At near the point of reversal, which is sought by skiascopy, the band of light, indicating regular astigmatism, is always most feeble; and this band, in the visual zone, may be entirely overlooked, while movements of light and shadow in other parts of the pupil are easily seen and receive most attention. On this account skiascopy has often been discredited and given up.

For the same reason subjective testing of refraction, when the pupil is widely dilated, is often contradictory and puzzling. The eye may see best with a lens that focuses light received through the periphery of the dilated pupil, which often

has less hyperopia or more myopia than the central visual zone. This error has often been charged to incomplete cycloplegia, when it was due to failure to recognize the visual zone.

Sometimes the amount of regular astigmatism, or the direction of its principal meridians, as found under cycloplegia, will be rejected in a postcycloplegic test. The shadow test may sometimes show two bands of light in the pupil, approximately parallel but moving in opposite directions, like the blades of a pair of scissors. This has been called the scissors movement. In conical cornea, for which the shadow test was first used, the light in the pupil seems to turn around the apex of the corneal cone. This was called by Batten, in 1897, conical astigmatism. A somewhat similar movement of the light band has been called the pendulum movement. In some cases this may indicate the principal meridians of astigmatism in one part of the pupil to be 20 degrees or 30 degrees different from their direction in another part of the pupil. In such a case the direction of the meridians in the visual zone must be carefully determined, or there may be an important difference between the cycloplegic and postcycloplegic corrections.

Failure to recognize what is the visual zone of the pupil has been the most common cause of disagreement about what is the best correcting lens, and wide disagreement as to the errors of refraction as measured with the ophthalmoscope. When the pupil dilates widely in the darkroom, it is difficult for the observer to know what part of the pupil he is looking through, to judge astigmatism by the fine retinal vessels. To avoid error and confusion as to the refraction of any eye, we must first recognize the visual zone of its pupil, and to make sure by repeated and postcycloplegic testing, what is needed to correct the part of the pupil the patient will naturally use, when he looks through his correcting glasses. Recognition of the visual zone is the most generally useful service skiascopy can render. It may well be supplemented by a final survey of the correcting lens, by postcycloplegic inspection of the pupil with a +2. spherical added to the correcting glass, at a distance of one-half meter.

Edward Jackson.

TOTAL COLOR-BLINDNESS

Theories, however pretty, do not prove themselves, and no one has yet proved, by one theory or another, that he is able to explain the anatomic basis of color vision. All our considerations of the subject are little better than pure speculation. However, we may interpret the intermediate combinations, it is probable that no one ever will explain the ultimate esthetic effect of color vision as expressed in the sensuous delight of seeing a pure red or green or blue.

The suggestion that the retina contains a different type of anatomic element for each of three primary colors sounds a trifle gross and mechanical in dealing with cerebral impressions of so refined and so varied a character. It appears more possible, although just as incapable of demonstration, that the subtle combinations are associated with some sort of variation in vibratory effect upon identical perceptive structures.

Only one serious attempt appears to have been made to show definite anatomic peculiarities in a case of complete color-blindnesss. Larsen reported in 1921 upon the histologic findings in a young woman who had died of pneumonia while employed in the eye department of the Rigshospital in Copenhagen. Microscopic examination of the retinas was said to have shown that the number of rods and cones

was normal but that the cones in the fovea were "short and coarse, whereas they are normally long and thin in this area." In a brother and sister with monochromasia, Ajo and Teräskeli made certain experiments from which they arrive at the conclusion that only the rods function in totally color-blind eyes.

Reports of anomalies in color vision have included a fairly gradual series of variations between full or even hyperacute color vision and the opposite extreme of total absence of this function. Complete color-blindness, according to some authors, is rather a part of a syndrome than an isolated defect. The classically complete case presents undulatory nystagmus, central visual acuity of 6/60 or less, photophobia, ability to see relatively better in a poor than in a good light, and various peculiarities as to the perception of the various wave lengths of the spectrum.

The dark vision of the monochromatic is said to be about as good as that of a normal person. He sees the spectrum shortened at the red end, and experiences the maximum of luminous intensity in the green instead of in the yellow. It is an interesting fact that the person with normal color vision experiences a similar limitation and a similar shift in maximum light intensity when the total illumination is reduced to the point at which colors can no longer be distinguished.

Total color-blindness is somewhat rare, although no doubt commoner than the number of reports in the literature would indicate. In 1926 Julia Bell was able to assemble 190 case records from the literature, 39 being accompanied by genealogic tables. Special investigations have pointed to the existence of sixteen cases in Switzerland, forty in Germany, twenty-two in Holland, and twenty in Sweden. When the syndrome is incomplete, the variations may consist of reduced degrees of photophobia and nystagmus, with better visual acuity. Other writers doubt whether these cases should be regarded as belonging to the typical group.

Achromatopsia is commonly regarded as a heriditary recessive. Typically, it does not occur in two successive generations, but may be found in several siblings (brothers, sisters, or brothers and sisters). Consanguinity, though not always easy to prove, has been regarded as playing an important part in the incidence of the anomaly. Among the series of cases which she assembled from the literature, Bell found consanguinity recorded in only 27.4 percent. Peter, in a similar survey, found consanguinity indicated in 23.5 percent. Waardenburg found consanguinity in 33 percent of the cases recorded in Holland. A recessive characteristic, in which consanguinity plays an important part, is likely to occur in a relatively greater proportion of the population of an isolated community, where intermarriage has been common and where matrimonial alliances with inhabitants of distant regions have been the exception.

Holm and Lodberg (Acta Ophthalmologica, 1940, volume 18, parts 3-4, page 224) were able to study such a community on the small Danish island of Fuur. Though separated by only a narrow strait from the neighboring peninsula of Salling, the island has nevertheless maintained "a strong island individuality and special customs and usages." A writer in 1768 described the islanders as seldom leaving their native soil, and a more recent description of Danish fisherfolk says that "a matrimonial union between a native of Fuur and a stranger was never graciously looked upon." The island has now (census of the year 1920) about 1,600 inhabitants. Families were usually large, and scientific investigation has been favored by the fact that the family records were preserved with great fidelity from one generation to another. In the most

generally affected families the eye condition was so well known "that the mothers could decide whether a child had the anomaly when it was only a couple of months old."

Göthlin's systematic study of the population of Sweden pointed to the probable existence of no more than one case of total color-blindness in every 300,000 of the inhabitants. Assumption of a similar proportion in Denmark would suggest a total of ten cases for that country. Yet, on the little island of Fuur, with its population of only 1,600 persons, Holm and Lodberg were able to gather records of twenty-three cases of the anomaly—an interesting commentary on the influence of many generations of intermarriage as regards the incidence of inherited defects.

Of the twenty-three subjects, ten were examined in person by the authors. Nineteen out of the total of twenty-three are members of a single pedigree which includes altogether three hundred persons. The remaining four affected individuals belong to a pedigree of fifty-seven persons.

The larger pedigree descended from a husband and wife and their brothers and sisters. In one family group monochromasy appeared by direct inheritance through three generations and then disappeared. In another branch of the same family the anomaly appeared in five successive children born after five healthy children. In one line of descent, three cases appeared in the first generation, none in the second, two in the third, and one in the fourth.

Although the family origins of both the large and the small pedigree could be traced back for two centuries, no relationship between the two pedigrees could be demonstrated. Yet their existence on the same small island makes such a relationship seem highly probable. In four of the twelve affected family groups consanguinity was known to exist. It may be justifiable to assume that remote consanguinity exists much more frequently than can be proved.

In their investigation, Holm and Lodberg did not find the anomaly to be accompanied uniformly by other visual disturbances. It occurred in families which were otherwise healthy. Only one affected family showed cases of insanity (three in number).

Fifteen of the individuals studied by Holm and Lodberg are still alive. It would be interesting to speculate to what extent their decrease without progeny would affect the incidence of this disorder in Denmark or elsewhere a century hence.

W. H. Crisp.

REALISTIC ORTHOPTICS REPORTS

Now that ophthalmologists are again tending to be enthusiastic over the idea of muscle training to cure tropias and phorias there is a tendency to dwell on the rosy side of the picture and to gloss over the discouraging features. There was presented a fairly typical report from the Los Angeles Clinic at the 1940 meeting of the Pacific Coast Oto-Ophthalmological Society. The discussers were pleased with the paper and the casual reader would be encouraged by it to do more orthoptics, but a careful analysis seems to change the picture somewhat.

Most American ophthalmologists began to be aware of abnormal retinal correspondence only following a splendid monograph of Travers published by the British Journal of Ophthalmology in 1936, although the subject was well known to many foreign oculists and had been in

the German literature for 25 years. This important element in the diagnosis and training of squint has since then received the consideration that it deserves. Success depends on its elimination if it exists. How often does it exist and how successful is its cure? The truth is that it is present in approximately half of the cases of squint and its treatment is very difficult.

Its frequent occurrence and unsatisfactory treatment is sometimes mentioned but seldom stressed. The ophthalmologist who attempts to treat tropias, however, finds this noncomitance to be a big stumbling block. Almost all of the patients whose eyes cross in the first year and most of those who show strabismus in the first two years of life have abnormal retinal correspondence. Breaking this up and restoring normal retinal correspondence is extraordinarily difficult. Cases in which treatment of squint has been successful are mostly those in which fusion has existed at some time before the crossing developed. Unwarranted encouragement for early fusion training is often given. Most doctors who actually give this training themselves find no success in patients under five years and in truth little can be done with the stereoscope until five and a half or six years have been reached. I have tried it myself and have worn out two assistants trying to break up abnormal retinal correspondence and training these patients to fuse. Lyle and Jackson reported 65 percent successes after an average of 49 supervised training periods! If the physician is prepared to give this amount of time and effort to the work no further comment is necessary.

The expression "eyes straight" after surgery alone or surgery and orthoptics is often used without definition of the exact meaning. If only apparently or cosmetically straight is intended the results will be far different than if truly straight, implying some degree of fusion, is intended.

Everyone who writes on the subject states that the phorias are more amenable to orthoptics than the tropias. Certainly this is true because there is no problem of strabismus, and we are dealing only with a minor difficulty, usually of poor anatomical set in the static position, so that development of convergence power is possible though this usually diminishes when exercises are discontinued. Not much effort is given in most clinics to the muscle care of patients with abnormal phorias. They have neither the time nor the money for training. They are almost always adults who have other demands on their time. The clinic muscle cases are mostly the strabismic. These patients are usually children, the majority of whom have abnormal retinal correspondence and, as stated, in few of these is training effectual in producing good fusion. A great deal of time and much patience is required. Doctors—even the young ones—will not, with rare exceptions, do this work. Practically, if anything is to be accomplished it must be done through paid technicians. At least one for each ophthalmic center seems desirable. The work will scarcely pay for itself. It is worth doing, but it is undeniably difficult and often unsatisfactory. Chavasse has written a brilliant monograph on the subject recently. It will repay careful study.

It is important to study all of the facts and be sure that the reports do not gloss over the difficulties and so give erroneous impressions in the desire to paint as bright a picture as possible. Accurate reports are valuable. Those composed only of generalities are worse than useless.

Lawrence T. Post.

INDUSTRIAL OPHTHALMOLOGY

The tremendous upward surge of industrial production, especially in the metal trades, as a result of the impetus of the defense program that this country is now undertaking, will of its very nature show an increase in the number of ocular injuries. This will occur in spite of an awareness on the part of employer as well as employee of the importance of protective devices of all kinds and the installation of proper facilities for the care and treatment of ocular injuries. This awareness has been growing steadily, regardless of many instances in the past of carelessness and neglect on the part of both management and labor. The ophthalmologist, too, has not been entirely blameless in helping to solve the problem of industrial hazards to the eye. Too often he has neglected his responsibilities toward prevention, as witness the large number of books and articles concerning the treatment of ocular injuries and the relatively few on their prevention.

Harry Best in his splendid book on "Blindness and the blind in the United States" (published by Macmillan, New York, 1934) states that "over one fifth (22.3 percent) of blindness is caused by external forces of some kind, or results from causes other than disease." Students of the subject have estimated that "fifty million dollars is lost every year by employers and employees of American industry as the direct result of preventable injuries of the eye. This sum is the estimated cost of compensation paid, medical care received, and time lost. This does not include the direct losses, which are considerably greater" (Allen and Carman, "Protective equipment for eyes in industry," Journal of the American Medical Association, 1941, volume 116, March 29, page 1343).

For example, a workman had an intraocular steel magnet-extraction operation performed on his left eye. In spite of early care (within two hours of the injury) the eye was infected, and costly treatment with sulfanilamide, foreign proteins, and so forth, was without benefit. The eye was enucleated at the end of 10 days' hospitalization of the patient, and the man was back in the factory doing what work a one-eyed man was permitted to do at the end of another two weeks. Cost of the injury to the Industrial Commission was well over three thousand dollars, including the workman's compensation; and the cost to the man himself was one eye and hours of pain and grief. Multiply this single instance by the thousands that occur annually and one can see at once the price paid for accidents that are always preventable in every instance. Mr. H. Guilbert, safety director of the Pullman Company, backs up his statement that "of all the injuries sustained by industrial workers, those to the eyes are utterly preventable and wholly inexcusable" by reporting that it had been over 10 years since anyone of his concern's 22,000 employees had lost an eye or suffered partial loss of vision (cited by Allen and Carman).

Those of us who were so fortunate as to hear Dr. Hedwig S. Kuhn present her magnificent paper on "An appraisal of visual defects in industry" before the American Academy of Ophthalmology and Otolaryngology in October, 1940, were impressed by the caliber of her work and its significance to industry and ophthalmology. In 16,332 industrial eye examinations she found that 21 percent of the individuals had a visual acuity below 20/30 and 12 percent had not been corrected with glasses. The Life Extension Institute in an examination of 10,000 employees of diversified industries found 13 percent wearing glasses, but 53 percent had uncorrected defective vision (cited by A.

Culler, "Visual efficiency in industry," Journal of the American Medical Association, 1941, volume 116, March 21, page 1349). What part defective vision contributes to accidents it is difficult to estimate, but its importance cannot be minimized.

The papers by Allen and Carman, A. Culler, and L. Greenberg presented before the Third Annual Congress on Industrial Health in Chicago, January 14, 1941, and published in the Journal of the American Medical Association, 1941, volume 116, March 29, pages 1343-1360 are of such value that every ophthalmologist should read and study them. Each contains information on industrial ophthalmology that is indispensable to the practicing ophthalmologist. The studies range from protective devices to medicolegal aspects and point out many errors and examples of injustice to worker and employer alike that common sense and aggressive action would easily eliminate.

The ophthalmologist has for too long a time maintained a lukewarm attitude toward these questions. The shirking of our responsibilities has been partly due to professional shyness toward industry but also in a large measure to the fact that too often we, as a body, have not been consulted. The safety director, employer, employee, and ophthalmologist acting together can wipe out hazards and by adequate measures reduce the incidence of industrial ocular injuries.

Derrick Vail.

BOOK NOTICES

TEXTBOOK OF OPHTHALMOLOGY. By Sir W. Stewart Duke-Elder. Volume III, Diseases of the inner eye. Crown quarto xxvii and 1,373 pages with 1,140 illustrations, including 164 in color. St. Louis, C. V. Mosby Company, 1941. Price $18.50.

Volume III of this magnificent book is unsurpassed in ophthalmic literature. The diseases of the inner eye are considered carefully by a research physiologist, pathologist, and clinician, whose clarity and literary style are faultless. As a reference book of ophthalmology it will be quoted with an air of finality comparable to quotations from Fuchs's textbook.

Diseases of the uveal tract, pages 2097 to 2544, are considered as ocular complications of systemic diseases. The following quotation summarizes this relationship and reveals the author's ability to state concisely and clearly an obscure problem. Referring to uveitis: "The most common infection is streptococcal; tuberculosis acting allergically from a focal lesion usually in a mediastinal gland probably comes second. Of the streptococcal foci the most common are the teeth and tonsils, thereafter and less frequently the nasal sinuses, then the posterior urethra and prostate and the pelvic organs in women, and only rarely the intestinal tract with its diverticula, the gall-bladder and appendix." Third place is held by syphilis, fourth by metastatic lesions.

In dealing with the unfortunate complications of uveitis and secondary glaucoma Duke-Elder advises the use of atropine in massive amounts combined with repeated paracenteses. Tuberculous uveitis is best treated with *rest;* tuberculin used in small desensitizing amounts is approved.

The section on diseases of the retina, pages 2544 to 2926, covers the vascular changes found in the fundus in cardiovascular-renal diseases of the system. The section on retinal detachment or rather retinal separation is a monograph and includes the most recent references.

Diseases of the optic nerve, pages 2927-3101, are considered in great detail and are especially well illustrated. Throughout this section, as in other sections, one is

struck with the number of recent references that are available.

Diseases of the lens, pages 3103-3244, are presented etiologically as a problem in physiological chemistry. The illustrations of the biomicroscopic appearance of the lenticular changes are excellent.

The chapter dealing with glaucoma, pages 3280-3429, again reveals the happy combination of physiologist, pathologist, and clinician, who has the ability to organize material and present it clearly.

This book is monumental and is a tribute to the work of all contributors in the field of medicine and ophthalmology.

William M. James.

THE TRANSACTIONS OF THE AMERICAN OPHTHALMOLOGICAL SOCIETY. Volume XXXVIII, 583 pages. Philadelphia, Wm. F. Fell Company, 1940.

This annual publication follows the form of previous years. The volume is larger than formerly and is printed on a better grade of paper, which improves the quality of the photographic reproductions. Thirty-five papers are recorded: 18 are devoted to pathology, 5 to surgery, 2 to functional testing, 3 to therapy, 3 to physiology, 1 to refraction, 1 to vitamins, and 2 are miscellaneous in subject matter.

M. H. Post has improved his solution used for the chemical sterilization of cutting instruments. The solution sterilizes with a one-minute exposure, is cheap and harmless.

Vail reports the successful treatment of a retinal detachment complicated by a scleral staphyloma. Recovery followed the excision of the staphyloma.

Swab records three deaths following cataract extraction: One from a late infection of the wound (meningitis followed enucleation); one from bronchopneumonia; and one from a paralytic ileus.

Chance reviews the results of removing cloudy lenses in high myopia (over −12.00 diopters). The operation is well tolerated and the results are good.

Kirby reports the first glomus tumor of the eyelid on record. This unusual tumor consists of an anastomosis of arteries and veins accompanied by smooth-muscle fibers, nerve fibers, and "epithelioid glomus cells."

Evans describes a scotoma associated with menstruation. The scotoma is wedge-shaped with the apex at the blind spot.

Thygeson has obtained excellent results by treating inclusion conjunctivitis with sulfanilimide. He advocates 0.1 gm. per kg. of body weight for six days or longer.

Gundersen's second report on the use of convalescent blood for the treatment of herpes zoster ophthalmicus is encouraging. A transfusion of 250-400 c.c. of convalescent blood given before the ocular infection is well established is advocated.

Bruce describes the relatively unknown disease due to deficient lacrimation. This entity *keratoconjunctivitis sicca* is treated satisfactorily by closing the canaliculi by actual cautery.

Adler and Scheie believe that tonic pupils are caused by a partial denervation of the parasympathetic supply to the pupil at or peripheral to the ciliary ganglion. A sensitivity to mecholyl aids in differentiating the tonic pupil from the Argyll-Robertson pupil.

Berens and Nilson have produced an experimental iridocyclitis in rabbits by injecting intravenously 2 c.c. of a broth culture of a coliform bacteria. The bacterial strain used in this amount caused a mortality of 65 percent.

Edward Jackson's paper "The function and structure of the eye" deals with (1) the cause of the transparency of the ocular media, (2) the resilience of the cor-

nea, and (3) the function of the retinal pigment in the metabolism of the eye.

Prangen's consideration of Sturm's interval and the advisability of prescribing equivalent lenses in dealing with spherical and cylindrical combinations is very lucid and practical.

Heath discusses in detail the role of the lens in secondary glaucoma: (1) when out of position, and (2) by direct irritation of the iris or ciliary body either by contact or by elaborating a toxic substance. He advises the removal of the lens.

Beach and Holt report eight cases of glaucoma following mydriasis. The use of strong miotics was successful in reducing the tension.

Chandler's paper on the intradiem tension studies in chronic simple glaucoma is excellent. The presence of glaucoma with consistently low tension has forced him to conclude that: (1) the normal tension may be 8 to 10 mm. Hg (Schiötz), so that 18 to 25 mm. is a dangerous elevation, (2) the accepted normal levels may be accompanied by intermittent higher levels of tension, or (3) possibly at some previous time actual glaucomatous levels of pressure existed.

Culler's thesis on "Fractures of the orbit" with the demonstration of orbital structures by planigraphy (body-section radiography) is very fine. Fractures of the orbit that endanger vision should be reduced as soon as possible.

Elles records a case of rhinosporidiosis infection in the eye.

Greear's study of the eye in hypertensive cardiovascular disease includes a comparative ophthalmoscopic and pathological examination of 16 patients. The excellent service which the Army Medical Museum offers to eye physicians is shown clearly.

Hildreth's anatomical studies have clarified the surgery of the levator palpebrae muscle. The technique advocated is direct, simple, and satisfactory for handling partial paralyses of the levator palpebrae muscle.

Macnie has found that the virus of lymphogranuloma venereum is one of the causes of the oculoglandular syndrome of Parinaud and of inflammations of the uveal tract. Improvement follows the use of neoprontosil.

McKeown examined a series of 498 newborn infants and found retinal hemorrhages in 42.1 percent during the first 48 hours after birth.

Veasey's work with the vitamins of the B group is timely. Subclinical B-avitaminosis is widespread in all classes. In toxic amblyopia, retrobulbar neuritis, and certain corneal conditions benefit from vitamin-B administration can be expected.

This volume represents a great amount of original, practical work, and should be available to the profession at large. The quality and quantity of the material presented is indicative of the value of the society to the profession.

William M. James.

THE ANATOMY OF THE EYE AND ORBIT. By Eugene Wolff, M.D. Second edition. 364 pages, 242 illustrations. Philadelphia, P. Blakiston's Son & Company, 1940. Price $7.50.

The second edition of Wolff's familiar textbook on ocular anatomy is richer than its predecessor by 64 pages and 69 illustrations, some of which are in color. The clear print, neat labeling, and the high quality of the paper that were characteristic of the first edition are continued in this. The increase in subject material adds little to the bulk of the book.

The author has rewritten the chapter on the blood supply of the visual gateway, incorporating his own significant re-

search. This is a valuable addition for hitherto there has been little in the English medical literature on this topic. The lucid descriptions and apposite illustrations permit one readily to understand the complex subject and suggest many clinical applications of the anatomic knowledge displayed.

The note on the differential staining of the rods and cones is illustrated in color, and demonstrates in beautiful fashion the fact that the cones are made of different material from the rods.

Among other important changes to be found is a series of pictures of flat sections of the retina from the author's preparations that give a much better understanding of this structure than is usual with the familiar vertical sections. New facts on the structure of the blood vessels are presented; for example, modern staining technique reveals that the typical iris vessel consists of two tubes, one within the other, and between them a space filled with a gossamerlike tissue, a structure apparently unique so far as vessels elsewhere are concerned. The author thinks that this is an arrangement to permit the concertinalike movement of the iris without disturbing the vessels, and makes for the greatest freedom of movement of the blood current.

The practicing ophthalmologist, as well as teachers and students of the subject, will find this book essential and profitable in their work. The author and publishers deserve the highest praise and gratitude.

Derrick Vail.

PRACTICAL ORTHOPTICS IN THE TREATMENT OF SQUINT. By Keith Lyle and Sylvia Jackson. Second edition. Cloth binding, xvi + 341 pages, 101 illustrations including 5 plates. London, H. K. Lewis and Company, Ltd., 1940. Price 15s. net.

The second edition of this book on the treatment of squint follows the same general arrangement used in the first edition. The book, however, has been revised as to details throughout, and considerably amplified in certain sections. The addition of two new chapters, and a greater elaboration of some of the more complex of the subjects considered in the first edition, make this edition more complete, but do not make it less easily read and understood.

The authors again stress the importance of an adequate number of orthoptic treatments, over a sufficiently long time, in well-selected cases, and with the constant supervision of a trained orthoptist. For their patients cured by orthoptics alone, the average number of attendances per patient has been 48 and has extended over four or five months.

The first six chapters of the new edition deal with the more general aspects of the causes, types, and methods of treatment of strabismus, and include the first of the new chapters, chapter III, which quotes largely from Bernard Chavasse's "Worth's squint" to give an etiological classification of strabismus.

Chapters VII, VIII, and IX discuss abnormal retinal correspondence, simultaneous perception and suppression, and fusion and stereoscopic vision, respectively, all in a practical manner. Cases are presented to show the importance of determining the presence or absence of abnormal retinal correspondence before instituting orthoptic treatments. Definite harm may be done if this condition is not recognized when present, and if exercises are, therefore, not properly selected and conducted. The authors believe it best, when possible, to correct the abnormal correspondence or suppression before operation, so that the binocular hold will help the patient overcome any small angle of deviation remaining after the operation.

Chapter X deals with the principles involved in considering whether or not to operate on a patient with strabismus, and what operations are indicated in the different types of squint.

The remaining chapters, chapters XI to XVII, take up the problems presented in the treatment of the different types of squint, concomitant and paralytic, manifest and latent. The second new chapter in the book, chapter XIV, describes the different conditions met with in adult cases of squint, and what methods were found best in handling them. The material on paralytic squint and ocular torticollis has been considerably increased as to detail and scope.

Finally, in this edition, instead of having tables of "results of treatment" in each chapter following the discussion of each separate variety of strabismus, the results obtained in the patients seen and treated during the year 1938 have been gathered together in tabular form in an appendix at the back of the book. This enables the reader to secure a quicker appraisal and comparison of these findings.

The book is interesting and informative. It is encouraging in showing that orthoptic treatment with or without operation is effective in a fairly high percentage of cases; but somewhat discouraging because it reveals the exacting work necessary to obtain success. It is worthwhile to the novice in orthoptics because of the clarity of its discussion, and to the more experienced in that it provides comparison of methods and results.

James H. Bryan.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

ASSISTED BY DR. GEORGE A. FILMER

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

5

CONJUNCTIVA

Mineev, T. **Treatment of trachoma in military candidates.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 142.

A description of the methods of therapy for military candidates, who are called for an examination two years before they reach military age and are hospitalized for treatment if found infected. Their families are then followed up and treated at the trachoma dispensaries. Treatment is continued from one to three years. Ray K. Daily.

Muradian, E. A. **Treatment of trachoma with antimony.** Viestnik Opht., 1940, v. 17, pts, 1-2, p. 96.

Muradian reviews Derkač's article (Amer. Jour. Ophth., 1938, v. 21, p. 218), and reports the results of 16 cases treated with intravenous injections of antimony. The results fail to confirm Derkač's claim of the effectiveness of this therapeutic agent in trachoma.

Ray K. Daily.

Panneton, Philippe. **Local treatment of gonorrheal conjunctivitis with sulphanilamide powder.** Amer. Jour. Ophth., 1941, v. 24, March, pp. 314-321.

Pfingst, A. O. **Accidental involvement of the eyes in vaccinia.** Amer. Jour. Ophth., 1941, v. 24, March, pp. 257-263; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 138.

Pick, **Treatment of chronic conjunctivitis and blepharitis.** Ophthalmologica, 1940, v. 100, Oct., p. 208.

The author describes in detail his methods of treating patients with chronic conjunctivitis and blepharitis. In eyes with conjunctivitis characterized by a congested thickened membrane with copious exudate, organic silver preparations are indicated. It is advisable to irrigate thoroughly after such treatment to prevent argyrosis. When the conjunctiva is anemic and the meibomian glands are not visible, silver is contraindicated. In such pa-

tients Pick uses 0.2-percent zinc sulphate, 2-percent sodium salicilate, 3-percent potassium chlorate, or an astringent collyrium. Irritating solutions and local anesthetics are avoided. Patients having foreign-body sensations in the morning accompanied by dried granules of secretion are advised to instill creamy milk at night.

Resistant disease is treated by scraping the conjunctiva and then brushing thoroughly with a wire brush. The new-formed epithelium is usually healthy and remains so for several years. When the meibomian glands are involved, the author splits the lid at its edge and scrapes the glands. He has never had any ill effects.

F. Herbert Haessler.

Radzichovskii, B. L. **The separation of the pterygium from the cornea.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 139.

The author introduces two strabismus hooks under the neck of the pterygium and, by pulling them in opposite directions, he separates the head of the pterygium from the cornea. (Illustrations.) Ray K. Daily.

Shein, I. S. **Treatment of trachomatous pannus by transplantation of conserved sclera.** Viestnik Opht., 1940, v. 17, pt. 3, p. 225.

Three cases with good results are reported. A ribbon of sclera with the overlying conjunctiva was implanted around the limbus. The transplants showed no evidence of absorption after eleven months. The transplant may be sutured to the tendons of the recti muscles. Ray K. Daily.

Sverdlin, V. I. **Treatment of trachoma with antimony.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 93.

Thirty-five cases of trachoma were treated with intravenous injections of antimony potassium tartrate. The result was subjective relief and a transitory improvement in pannus, but there was no effect on the conjunctival process. This study therefore fails to confirm Derkač's contention (Amer. Jour. Ophth., 1938, v. 21, p. 218) that antimony is a specific against trachoma.

Ray K. Daily.

Weskamp, Carlos. **Hyperkeratosis (tyloma) of the tarsal conjunctiva.** Anales Argentinos de Oft., 1940, v. 1, July-Aug.-Sept., p. 325.

A man of 65 years, without keratosis of the skin, was treated with radium for an epithelioma of the skin of the right eyelid. Almost a year later there appeared in the tarsal conjunctiva a grumous white plaque which was easily detached, but always returned, even after surgical extirpation. Histologically the epithelium was greatly thickened by a granular layer, a clear layer and a separate layer with horny lamina carrying schizokeratin. The literature contains a few cases of the same histologic aspect, and generally given the title "tyloma," or keratosis of the conjunctiva. Most of these cases differ from the present one by their clinical aspect, their localization (almost always in the bulbar conjunctiva), and failure to recur. W. H. Crisp.

Zakharof, A. P. **Surgery of pterygium.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 135.

The author modified the McReynolds operation by excision of the head and of the thickened subconjunctival tissue of the pterygium. (Illustrations.)

Ray K. Daily.

6

CORNEA AND SCLERA

Chechik-Kunina, E. A. **Seasonal effect on scrofulous keratoconjunctivitis.** Viesnik Opht., 1940, v. 17, pts. 1-2, p. 37.

A comprehensive review of the literature and an analysis of the material at the Helmholtz Eye Institute at Moscow. The data show a rhythmic incidence of scrofulous keratoconjunctivitis, with the maximum number of cases in the spring, when the noon-day sun is at 50°. The radiation of the sun in this position, poor in ultraviolet, has a sensitizing effect on the allergic factor in scrofulous keratoconjunctivitis. The author proposes that children who are allergic to tuberculin shall be desensitized with ultraviolet rays before the advent of spring.

Ray K. Daily.

Dischkov, S. A. **Corneal transplantation in the Kalinin Eye Hospital.** Viestnik Opht., 1940, v. 17, pt. 3, p. 199.

An analysis of 57 cases. Their clinical course indicates the suitability of cadaver cornea for transplantation. The age of the host or donor has no significance. The determining factor is the character of the leucoma. For best results in adherent leucomas, and to avoid glaucomatous complications, preliminary iridectomy should be performed. In cases without incarceration of the iris in the scar, intensive use of mydriatics should keep the iris away from the transplant. Upon the development of increased intraocular tension, antiglaucomatous operations should be undertaken without delay. (Illustrations.)

Ray K. Daily.

Graves, Basil. **"Bilateral (mesial) deficiency of the sclera": scleral plaques.** Brit. Jour. Ophth., 1941, v. 25, Jan., pp. 35-38.

Graves reports another case of scleral plaques. (The title "bilateral deficiency" is used only for the sake of continuity of reference.) Three previous articles are referred to: two by the author (Amer. Jour. Ophth., 1938, v. 21, p. 221; and 1939, v. 22, p. 943) and one by Culler (Amer. Jour. Ophth., 1939, v. 22, pp. 457). (Figures.)

D. F. Harbridge.

Hamilton, J. B. **A survey of superficial punctate keratitis in Tasmania, with the record of a mild epidemic.** Brit. Jour. Ophth., 1941, v. 25, Jan., pp. 1-17.

The observations of the author are based on 92 cases (with 117 eyes affected) culled from 6,662 consecutive case records. In 25 instances there was bilateral involvement. Marginal keratitis, the most frequent of the allied conditions, corneal ulceration, which was common in the epidemic, disciform keratitis, of which the author found no association dendritic ulceration, and iritis, are discussed as conditions related to the degree in which the 117 eyes were affected. Paintings with 2-percent silver nitrate restored the eyes to normal within two weeks, the duration of treatment being 7.3 days. (Tables, graphs, references.)

D. F. Harbridge.

Khayoutin, S. M. **The effect of thyroidectomy and administration of thyroxin on experimental allergic keratitis.** Viestnik Opht., 1940, v. 17, pt. 3, p. 269.

A detailed report of a laboratory investigation on rabbits. These had been sensitized to horse serum and an allergic keratitis produced by injection of

horse serum into the cornea. A thyroidectomy performed a month prior to the beginning of sensitization definitely reduced the intensity of allergic process in the cornea and conjunctiva. The administration of thyroxin one month prior to the beginning of sensitization and continued during the sensitizing period also reduced the allergic phenomena, but to a smaller degree than thyroidectomy. The author explains these paradoxical results thus: thyroidectomy reduces the state of sensitivity of the animal, and the sensitizing injection produces a lower degree of allergy. The thyroxin acts on the inflammatory process itself, by increasing the activity of the reticuloendothelial system so as to cause a greater production of antigen. (Illustration.) Ray K. Daily.

Kiparisov, H. M. **Xerosis of the cornea among glass blowers.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 100.

In the routine examination of 600 workers in a glass factory, 14.6 percent were found to have ocular disturbances. Of these, 1.3 percent had cataract, but the relation between their work and the lenticular opacities was not definite, because these workers were all over forty years old. Conjunctival hyperemia, found in 11.6 percent of the workers, cleared up two or three hours after work. There was one case of blepharospasm in a man who worked without glasses before an open fire. Eight cases of corneal xerosis indicated the deleterious effect of the heat and light in this industry. Two cases of optic neuritis could be attributed to the effect of ultraviolet rays. The author urges that workers have their eyes examined before entering the industry, and that the administrative department of the industry be charged with the responsibility of providing and enforcing all prophylactic measures.

Ray K. Daily.

Mitzkevich, L. D. **The mechanism of corneal hematoma.** Viestnik Opht., 1940, v. 17, pt. 3, p. 252.

A review of the literature and a report of two cases. An oval red spot 3 by 4 mm. was seen under the uninjured epithelium at the first dressing following an extracapsular cataract extraction in an eye with fine corneal vascularization of undetermined etiology. With the biomicroscope the spot was seen to lie deep in the cornea, close to Descemet's membrane. After four months its size was much reduced. The factors accounting for this phenomenon are the presence of old obliterated vessels in the cornea, the disturbed relation between the corneal stroma and Descemet's membrane due to an old inflammatory process, the operative corneal trauma, and the consequent restoration of circulation in the obliterated vessels. In the second case a cataract extraction was complicated by mild traumatic iritis and spastic entropion. Following the injections at the external canthus in preparation for canthoplasty, a blister 2 by 4 mm. suddenly appeared on the lower portion of the cornea. On puncture blood exuded, and the epithelium flattened. In this case the hemorrhage must be attributed to rupture of a limbal vessel with separation of the epithelium from Bowman's membrane, caused by the preparatory manipulations.

Ray K. Daily.

Petrosiantz, E. A. **Late results of corneal transplantation.** Viestnik Opht., 1940, v. 17, pt. 3, p. 190.

A follow-up of 71 cases operated on from 1 to 8 years previously at the

Filatov clinic. Of these, 65 remained transparent. In six cases the transplant became opaque due to glaucoma. (Illustrations.) Ray K. Daily.

Petrunia, S. P. **Fixation of the corneal transplant in cases complicated by loss of vitreous.** Viestnik Opht., 1940, v. 17, pt. 3, p. 187.

The author has designed a plastic prothesis which he places over the cornea to dam back the vitreous and hold the transplant in place. A curved hook shoves the transplant under the prothesis. (Illustrations.)

Ray K. Daily.

Puchkovskaja, H. **The regenerative properties of the corneal epithelium.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 23.

The experimental investigation on guinea pigs consisted of two parts. A vertical cut was made through the epithelium and part of the substantia propria of the cornea of dead guinea pigs. The lids were sutured and the animal cadaver kept at 14° to 15°C.; at intervals from two to 72 hours the eyes were enucleated and sectioned. In the second series the eyeballs were traumatized in the same manner, enucleated, and kept immersed in running Ringer's solution at 31°C. After incubation for from one to 48 hours, the eyes were examined. The data show that the corneal epithelium has the ability to regenerate at a temperature of 14° to 15° after the death of the organism, and under artificial conditions. The most active regenerative process manifests itself during the first few days after death. In warm Ringer's solution the corneal epithelium completes the regenerative activity within the first 24 to 36 hours. The number of mitotic figures in these processes is insignificant. During regeneration in the cadaver as well as under artificial conditions the process consists in active ameboid movements of the epithelial cells toward and over the defect; the superficial epithelial cells play the most important part in this process. Small cells with intensely staining nuclei are constantly found among the cells covering the defect, as well as at the edges of the wound; these cells appear to come from the superficial epithelial cells. (Illustrations.) Ray K. Daily.

Shein, I. C. **Hematoma of the cornea.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 144. (See Section 8, Glaucoma and ocular tension.)

Velter, C. L. **Pathologic anatomy of the human corneal transplant.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 3.

The material consisted of 18 transplants; 15 being obtained when a secondary transplant was used to replace the primary transplant because of inadequate transparency. In three cases the eyes were enucleated for glaucoma. The micropathologic changes are insignificant in transparent transplants, more marked in semitransparent transplants, and very marked in those that become opaque. The most frequent change is a thickening of the epithelial layer; occasionally it is thin and vacuolated. Bowman's membrane is usually normal. The substantia propria is but slightly altered, or there may be thickening, splitting, and abnormal arrangement of the corneal lamellae. Descemet's membrane is retained in over half of the cases, and is usually detached and curled. The endothelium was absent in all cases. In each instance the transplants showed better morphologic differentiation than the corneal scars. The demarcation between the trans-

plant and the scar was in all cases very sharp. Membranes behind the transplant were found in seven out of the 18 cases; in six they originated from the corneal scar. The iris, adherent to the transplant, is not the source of the connective tissue which invades the transplant. (Photomicrographs.)

Ray K. Daily.

Wasserman, I. A. **Amelioration of leucoma.** Viestnik Opht., 1940, v. 17, pt. 3, p. 179.

A report of 12 cases of replacement of the superficial layers of leucomata with sections of cadaver cornea, preparatory to corneal transplantation. Of 12 cases thus treated eight showed transparency after the subsequent transplantations. The latter followed the preparatory operations by 2 or 3 months. Of the eight cases there was visual improvement in three; in the other five fibrous membranes behind the transplants vitiated the visual result.

Ray K. Daily.

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Adler, F. H., and Scheie, H. G. **The site of the disturbance in tonic pupils.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 183.

The disturbance in tonic pupils is said to be a partial denervation of the parasympathetic supply to the pupil at or peripheral to the ciliary ganglion. Mecholyl is of diagnostic value in differentiating tonic pupils from Argyll Robertson pupils.

David O. Harrington.

Dax, E. C. **A case of gyrate atrophy of the choroid and retina with hypogenitalism.** Brit. Jour. Ophth., 1941, v. 25, Jan., pp.18-23.

The condition described is rare, being first described by Cutler in 1894. The case reported is that of a man born in 1860, admitted as a mental patient in 1927. He was married in 1887, became obese twenty years later, never shaved, and had the appearance of an old woman. He had no axillary hair and had large breasts; he had had no children but his wife—also of low mentality—stated he was not impotent. Absence of myopia, recognition of the eye condition late in life, and the associated hypogenitalism and obesity coming on suddenly in middle age, are the points of interest. (Photomicrographs, test tables, references.)

D. F. Harbridge.

Henderson, Thomson. **The mechanism of aqueous secretion in mammalia.** Brit. Jour. Ophth., 1941, v. 25, Jan., pp. 30-35.

A recent article by Duke-Elder and his associates (Amer. Jour. Ophth., 1941, v. 24, p. 96) states that "there is no conclusive or indeed persuasive evidence that the intraocular fluid is a secretion." This statement is regarded by the author as invalid unless substantiated by suitable mechanical and structural data. Six conclusions are presented to show that the dialysis theory fails both in its original form and in its latest modification, filtrate-dialysis. (Figures, references.)

D. F. Harbridge.

Kronfeld, P. C., Lin, C. K., and Luo, T. H. **The protein content of the reformed aqueous humor in man.** Amer. Jour. Ophth., 1941, v. 24, March, pp. 264-276; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 192.

8

GLAUCOMA AND OCULAR TENSION

Kaminskaja, Z. A. **The peripheral innervation of the iris and intraocular tension.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 34.

The objective of this study was to determine what section of the sympathetic nervous system controls the intraocular tension. The peripheral innervation of the iris was blocked by injections of nicotine into the anterior chamber of the right eye of rabbits; the left eye was used as a control. The test for the sensitivity of the peripheral nerves in the iris was the pupillary reaction to pain and simultaneous rise in intraocular tension. In nine rabbits out of twelve, the effect of the injections was a loss of the reaction to pain and of the rise in intraocular tension; this loss lasted a month. Since nicotine is a ganglionic toxin it is to be assumed that it blocked the synapses in the iris.

Ray K. Daily.

Mescherski, H. H. **Drill-trephine.** Viestnik Opht., 1940, v. 17, pt. 3, p. 222.

A description of a trephine which combines the advantages of the Hippel and Filatov instruments. (Illustrations.) Ray K. Daily.

Meyer, S. J., and Holstein, T. **Spherophakia with glaucoma and brachydactyly.** Amer. Jour. Ophth., 1941, v. 24, March, pp. 247-257.

Shein, I. C. **Hematoma of the cornea.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 144.

Iridencleisis, performed in a case of advanced secondary glaucoma, was complicated by hyperemia and hemorrhage into the substantia propria of the cornea. The blood was completely absorbed within a year. Ray K. Daily.

Shevchuk, I. P. **Late results of Elliot's operation in glaucoma.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 51.

Shevchuk presents an analysis of 123 cases followed from two to 20 years. In 87 percent of the cases a permanent normalization of tension was obtained. Visual acuity frequently continued to fail in spite of normal tension, the more so the more advanced the disease at the time of operation. Apparently intraocular tension is not the only factor in the continued destruction of the optic nerve in glaucoma. A flat filtering cicatrix spreading beyond the trephine opening is the result to be desired from the operation. There was less recurrence of intraocular hypertension among cases with total iridectomy. There were four cases of late infection; in three the infection entered through a defect in the cicatrix, and in one it followed an acute conjunctivitis.

Ray K. Daily.

9

CRYSTALLINE LENS

Brückner, Roland. **The acid-soluble phosphates in the lenses of various animals.** Ophthalmologica, 1940, v. 100, Oct., p. 203.

The author analyzed eighty lenses from six species of mammals and four of fish. The lenses of the fish had a somewhat higher content of total acid-soluble phosphate than the adult mammals, and a lower water content. Kittens had a remarkably high acid-soluble phosphate content.

F. Herbert Haessler.

Meyer, S. J., and Holstein, T. **Spherophakia with glaucoma and bra-**

chydactyly. Amer. Jour. Ophth., 1941, v. 24, March, pp. 247-257.

Riddell, W. J. B. **The chi-square test of significance applied to a series of intracapsular cataract extractions.** Brit. Jour. Ophth., 1941, v. 25, Feb., pp. 49-57.

This paper demonstrates the application to clinical problems of the method advocated by Fisher. A series of 122 senile cataract extractions is reviewed the intracapsular method being found appropriate in 88 cases. Removal of the lens intact within its capsule gave better visual results than were had in those cases where the capsule ruptured. (Tables, references.)

D. F. Harbridge.

Salit, P. W. **Droughts as factors in the development of senile cataracts.** Amer. Jour. Ophth., 1941, v. 24, March, pp. 310-314.

Shartz, S. E. **A loop for lens extraction.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 92.

In the opening of the Weber loop the author inserted a fine wire net in the form of a cross. This prevents small lens nucleus or pieces of the lens from escaping through the open loop into the vitreous. (Illustrations.)

Ray K. Daily.

Swab, C. M. **Death following operation for cataract.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 59.

The possibility of fatalities after cataract extraction is discussed. Three cases are reported, in each of which death was not directly due to the operation but may have been precipitated by it. David O. Harrington.

Theobald, G. D. **The histologic examination of an eye from a child suffering with arachnodactyly.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 235.

The first histologic report on an eye in a case of arachnodactyly. Influences responsible for this condition are discussed together with its hereditary and familial character and theories as to the origin of the syndrome.

David O. Harrington.

10

RETINA AND VITREOUS

Chavira, R. A. **Tension of the central retinal artery in cranio-encephalic traumatisms.** Anal. de la Soc. Mexicana de Oft. y Oto-Rino-Laring., 1939, v. 14, Oct.-Dec., p. 209.

The simple technique of retinal sphygmoscopy ought to be applied to cases of injury of the cranium, in cardiorenal cases, in patients with hemorrhagic lesions of the retina and of the vitreous, in neuropathies, and in patients suffering from cerebral angiospasm. Diagnostic points in the various circulatory types are discussed. A knowledge of the physiopathology of the central artery of the retina furnishes indications for the general care of the patient. W. H. Crisp.

Dax, E. C. **A case of gyrate atrophy of the choroid and retina with hypogenitalism.** Brit. Jour. Ophth., 1941, v. 25, Jan., pp. 18-23. (See Section 7, Uveal tract, sympathetic disease, and aqueous humor.)

Dax, E. C. **A case of juvenile amaurotic idiocy with disturbances in water-salt metabolism.** Brit. Jour. Ophth., 1941, v. 25, Jan., pp. 24-30.

The case described is that of a young woman (exact age not stated but presumably in the early twenties).

The past history showed a normal

development until the age of eight years when the sight began to fail. Convulsions started at the age of thirteen years. The patient first attended a school for the blind but left there for an epileptic colony after the onset of attacks. At eighteen she became paranoidal, and other symptoms, such as hallucinations, screaming, brooding, chattering, and loss of temper became manifest. A younger sister was similarly affected. An abnormality of water-salt metabolism was found. (Photograph, tables, references.)

D. F. Harbridge.

Essaylova, Z. A. **Therapy of diseases of the optic nerve and retina with retrobulbar injections of atropine and strychnine, combined with diathermy.** Viestnik Opht., 1940, v. 17, pt. 3, p. 263. (See Section 11, Optic nerve and toxic amblyopias.)

MacDonald, A. E. **Heparin in thrombosis of the central vein.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 313.

Theory of the action of heparin is reviewed. Its use in two cases of thrombosis of the retinal vein is reported. It is suggested that the drug should be used early to be effective. No definite conclusions are drawn as to its value.

David O. Harrington.

McKeown, H. S. **Retinal hemorrhages in the newborn.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 510.

Of 498 newborn infants 42 percent showed retinal hemorrhages during the first 48 hours after birth. Most common were flame-shaped hemorrhages superficial to the vessels, which are believed to cause no subsequent visual impairment. Least common were deeper hemorrhages which, if near the macula, are thought to cause permanent damage. Causes of the hemorrhages are discussed. The literature is reviewed. David O. Harrington.

Rychener, R. O. **Weve diathermy electrode.** Amer. Jour. Ophth., 1941, v. 24, March, pp. 322-323.

Sorsby, Arnold. **The nature of experimental degeneration of the retina.** Brit. Jour. Ophth., 1941, v. 25, Feb., pp. 62-65.

Tests were made to determine whether sodium iodate is as stable in the bloodstream as in vitro. Experiments included the testing of the stability of iodate in the blood in vitro, in the plasma, and in the bloodstream of the intact animal. Results and observations are offered with considerable reserve. (Figures, references.)

D. F. Harbridge.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Dammskaja, H. M. **Bilateral retrobulbar neuritis and paresis of the right superior rectus caused by dental infection.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 84.

Review of the literature and report of a case in which the usual treatment (operation on the maxillary sinus) and extraction of a diseased molar had no effect on the course of the disease in the left eye, which had only light perception. Only after extraction of another diseased molar on the right side did the process begin to subside. Vision of this eye was finally restored to 0.7.

Ray K. Daily.

Esaylova, Z. A. **Therapy of diseases of the optic nerve and retina with retrobulbar injections of atropine and**

strychnine, combined with diathermy. Viestnik Opht., 1940, v. 17, pt. 3, p. 263.

On the basis of a clinical experience of forty cases the author concludes that this therapeutic combination is more effective than atropine injections alone. Visual improvement was obtained in 84.8 percent of the cases; after from 4 to 6 months visual acuity was reduced to its original level, but improved again after a second course of injections. In early cases the improvement was more stable. Ray K. Daily.

12

VISUAL TRACTS AND CENTERS

Colson, Z. W. **The effect of alcohol on vision: an experimental investigation.** Jour. Amer. Med. Assoc., 1940, v. 115, Nov. 2, p. 1525.

Visual tests following the consumption of alcohol (on an average of eight to ten ounces) by 21 normal individuals showed no diminution of visual acuity, visual fields, or color vision. The near vision at 14 inches was also unaffected, but apparently the accommodation was not tested. Conventional tests for dark adaptation showed no appreciable effect on the shape of the recovery curve. Muscle-balance tests revealed no tendency to hyperphoria, but one subject showed a gradually increasing esophoria. In two subjects esophoria progressed to actual convergent strabismus with diplopia. One subject had definite exophoria at the onset and passed through a stage of orthophoria before becoming esophoric. Diplopia resulting from alcohol is associated with a reduction, not an increase, of convergence power and is dependent upon development of an esophoria too great to be overcome by the abduction power, although the latter remains unchanged. George H. Stine.

13

EYEBALL AND ORBIT

Cotlier, I. **Orbito-palpebral emphysema by rupture of the os planum of the ethmoid.** Anales Argentinos de Oft., 1940, v. 1, July-Aug.-Sept., p. 335.

A case of this rather common condition is described and illustrated, with a discussion of the anatomical factors involved.

Jackson, Edward. **Function and structure of the eye.** Amer. Jour. Ophth., 1941, v. 24, March, pp. 277-281; also Trans. Amer. Ophth. Soc., 1940, v. 38, p. 226.

Katznelson, A. B., and Strukov, A. I. **Pseudotumors of the orbit.** Viestnik Opht., 1940, v. 17, pt. 3, p. 237.

The authors review the literature and report two cases of apparent neoplasm connected with the periosteum of the lower orbital margin. Microscopically they presented pictures of inflammatory tissue, with many newly formed vessels and nodules of small round cells with intensely staining nuclei. (Photomicrographs.)
Ray K. Daily.

Sharkovskii, I. A. **A spontaneous hematoma of the orbit caused by hemophilia.** Viestnik Opht., 1940, v. 17, pt. 3, p. 256.

A man 26 years old with a history of hemophilia suddenly developed a retrobulbar hemorrhage and a hemorrhage into the lids of the right eye. He had at the same time an arthritis and symptoms of hemiparesis indicative of cere-

bral hemorrhage. The orbital hemorrhage absorbed in 17 days.

Ray K. Daily.

14

EYELIDS AND LACRIMAL APPARATUS

Gleserov, S. L. **Operation for ptosis.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 132.

A description of a modification of Elschnig's operation. The modification eliminates trichiasis, a frequent complication of this operation. (Illustration.) Ray K. Daily.

Hildreth, H. R. **The insertion of the levator palpebrae muscle.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 470.

A description of a modification of the Eversbusch operation for ptosis of the upper lid, based upon a better understanding of the anatomy of the area and particularly of the insertion of the levator palpebrae muscle.

David O. Harrington.

Maxwell, J. S. **Modification of the Hotz operation for entropion due to trachoma.** Amer. Jour. Ophth., 1941, v. 24, March, pp. 298-302.

Pick. **Treatment of chronic conjunctivitis and blepharitis.** Ophthalmologica, 1940, v. 100, Oct., p. 208. (See Section 5, Conjunctiva.)

Pokhisov, H. I. **Capillary test for the function of the lacrimal apparatus.** Viestnik Opht., 1940, v. 17, pt. 3, p. 278.

A review of the tests as to the function of the lacrimal apparatus. The author derives the most accurate information from the Riva test, and he urges its routine use. (Illustrations.)

Ray K. Daily.

Smelanskii, I. A. **Therapy of squamous blepharitis with castor oil.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 134.

After many other therapeutic procedures had failed, the author cured himself by the application of castor oil to the lids. Ray K. Daily.

Vila Órtiz, J. M., and Santa Maria, J. **Unilateral spasmodic retraction of the upper lid.** Anales Argentinos de Oft., 1940, v. 1, July-Aug.-Sept., p. 335.

The patient was a boy of eight years, whose general history was negative except as to the occurrence of measles in infancy. The boy's mother had noted that he slept with the left eye incompletely closed. Upon examination the left palpebral aperture was found wider than the right, the difference being due to retraction of the left upper and lower lids. The two eyes gave equal measurements with the exophthalmometer. No cause was discovered, but the author suggests a possible unilateral hyperactivity of the sympathetic.

W. H. Crisp.

15

TUMORS

Bikhovskii, M. A., and Kaganova, O. A. **Two cases of ocular lymphoma in aleukemic lymphadenosis with recovery under X-ray therapy.** Viestnik Opht., 1940, v. 17, pt. 3, p. 259.

A man 49 years old with a general lymphadenitis had a large orbital lymphoma originating from the lymphoid elements of the conjunctiva. In the other case, a girl 12 years old had a lymphoma of the right orbit and enlargement of the submental glands. Both cases responded to X-ray therapy. (Illustrations.) Ray K. Daily.

Meksina, F. M. **Adenocarcinoma of the lacrimal gland.** Viestnik Opht., 1940, v. 17, pt. 3, p. 243.

A review of the literature and the report of a case of seven years duration.

This case probably began as a mixed tumor which in time became malignant. The tumor recurred after exenteration of the orbit and the patient died of general metastasis. X-ray therapy was ineffective in preventing recurrence. (Photomicrographs.) Ray K. Daily.

Merkulov, I. O., and Zabotinskaja, P. H. **Data on ocular neoplasms.** Viestnik Opht., 1940, v. 17, pt. 3, p. 230.

The material consisted of 336 neoplasms seen between 1929 and 1936, and representing 0.46 percent of the total number of patients. Thirteen tumors were intracranial, 142 benign, 155 malignant, and 26 undiagnosed. Of the 332 ocular neoplasms, 173 were on the lids, 32 were epibulbar, 62 intraocular, and 53 were in the orbit. Of the lid tumors, 111 were benign and 51 malignant. Of the epibulbar tumors, 14 were benign and 14 malignant. Fifty-seven intraocular tumors were malignant, and five were undiagnosed. Of the 53 orbital tumors, 33 were malignant and 17 benign.

Ray K. Daily.

Smith, H. C. **Keloid of the cornea.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 519.

Smith reports a case of tumor of the cornea which seems to come under the classification of keloid. Thirty-seven similar cases are reported from the literature. The existence of primary fibrous tumors of the cornea has not been satisfactorily established.

David O. Harrington.

16

INJURIES

Bakarenkov, B. T. **Prophylaxis against ocular injuries from pitch at the Vitebsk railroad station.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 121.

At this station a running stream of water runs periodically over the sacks of pitch as they are being loaded and unloaded, thus preventing the pitch dust from flying in the air and irritating the conjunctiva. Ray K. Daily.

Bursuk, G. G., and Schultz, V. A. **Rational therapy of ocular burns.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 55.

The authors use frequent irrigations of warm Ringer-Locke solution, and an ointment consisting of the same chemical constituents. On the basis of results in 44 cases of severe corneal burns the authors believe this form of therapy superior to other therapeutic procedures. Ray K. Daily.

Culler, A. M. **Fractures of the orbit: the demonstration of the orbit by planigraphy (body section radiography).** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 348.

Fractures of the apex of the orbit are visualized with difficulty by ordinary X-ray technique. Culler describes a method for the blurring of extraneous shadows by the application of planigraphy to the X-ray study of the orbit. Clinical signs of fracture of the orbit and base of the skull are reviewed in detail. Treatment of fractures of the orbit is outlined and attention is called to the fact that it must be instituted within the first ten days.

David O. Harrington.

Khavin, A. O. **Alopecia with traumatic iridocyclitis.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 140.

A report of two cases of severe traumatic iridocyclitis, in which alopecia occurred during the period of severe pain. With subsidence of the pain the hair grew again. The author attributes

the phenomenon to irritation of the cervical sympathetic. Ray K. Daily.

Lokshin, C. I. **Surgical treatment of complicated iridodialysis.** Viestnik Opht., 1940, v. 17, pt. 3, p. 249.

A report of an extensive traumatic iridodialysis with the detached iris attached to the underlying remains of a traumatic cataract. By making a wide incision and pulling on the pupillary border of the iris with a cystotome, the ciliary border with the underlying lenticular remains was pushed into the wound and held in its lips. The encapsulated cortical masses of the lens were evacuated, with a good cosmetic and functional result. (Illustrations.)

Ray K. Daily.

Medvedjev, H. I., Zatz, L. B., and Zolotareva, M. M. **Comparative evaluation of the magnetic properties of various metals.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 110.

The authors review the literature and present a detailed report of a laboratory investigation of the magnetic properties of the various metals used in the manufacture of implements and ammunition. The data show that in order of magnetic effectiveness the large magnet with a conical tip comes first, then the large magnet with a curved tip, then the small magnet with a dull tip, and finally the small magnet with a curved tip. The sclera strongly reduces the attractive force of the magnet, which increases with the size of the foreign body. Iron is attracted through the greatest interval, and Hartfield steel through the least. Steel in the posterior ocular segment is not readily extracted through an opening in the anterior portion of the eyeball. In view of these facts the history of an injury is very important. The magnetic test should be made only for ophthalmoscopically visible foreign bodies. The use of weakly magnetic metals in industry calls for the development of very powerful electromagnets.

Ray K. Daily.

Sorsby, Arnold. **Experimental pigmentary degeneration of the retina by sodium iodate.** Brit. Jour. Ophth., 1941, v. 25, Feb., pp. 58-62.

Clinical cases are presented in which the use of a German iodine preparation produced a temporary or permanent loss of vision from pigmentary changes in the retina. Incrimination of sodium iodate as the toxic agent is indicated. (Figures, references.)

D. F. Harbridge.

Tokareva, B. A. **Pathology of an orbital injury with an indelible pencil.** Viestnik Opht., 1940, v. 17, pt. 3, p. 284.

A man 26 years old suffered a penetrating injury of the orbit from an indelible pencil. In spite of the usual therapy the wound did not heal. At surgical intervention an encapsulated piece of pencil was found deep in the wound. The diseased tissue was resected. The microscopic section showed absence of epithelial lining in the sac, a progressive aseptic necrosis of the surrounding tissues through diffusion of the dye, and a slow granulation and cicatrization after destruction of the tissue. Such cases call for immediate surgical excision of the stained tissue, and meticulous removal of every particle of the chemical dye.

Ray K. Daily.

Yañez, E. G. **Statistical study of 1,436 cases of foreign bodies in the eyes.** Anales de la Soc. Mexicana de Oft. y

Oto-Rino-Laring., 1939, v. 14, Oct.-Dec., p. 246.

Various statistical tables are given, dealing with age of patient, occupation, substance or nature of accident involved in traumatism, part of eye affected, and presence or absence of complications. The analysis as to complications is divided into two parts, one showing the complications occurring when first care was given by an ophthalmologist, and the other showing the complications arising in cases in which extraction of the foreign body had been attempted by a layman before the patient was seen by an ophthalmologist. The former group, as might be expected, was much more free from serious results than the latter. W. H. Crisp.

Zakrzevskaja, E. I. **The results of diascleral removal of foreign bodies.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 105.

An analysis of sixty cases. The conclusions are that this is a valid surgical procedure, the results of which depend on the size of the foreign body, the site of injury, the presence of complications, and the precision of surgical technique. Immediate operative intervention is not essential for a good result. The eye is tolerant to unsuccessful extractions and repeated operations. The lens was injured in 18 of these cases. Vision with correction was better in the cases in which the lens was uninjured. Two eyes were enucleated because of endophthalmitis. In two the foreign body could not be removed. In three cases there was a retinal detachment from two to four months after the operation; in one of these the sclera was electrocoagulated prophylactically. Diathermy following extraction of a foreign body is helpful in the absorption of vitreous hemorrhages and opacities.

Ray K. Daily.

17

SYSTEMIC DISEASES AND PARASITES

Bauer, Carlos. **A case of intraocular cysticercus.** Anales de la Soc. Mexicana de Oft. y Oto-Rino-Laring., 1940, v. 15, Oct.-Nov., p. 299.

A man came complaining of a shadow noted in the left eye, upward and outward. Ophthalmoscopic examination showed a large whitish-yellow spot, shaped like an egg, in the lower inner region of the fundus, fairly near the disc. In the periphery of this mass was a small, intensely white spot, which seemed to change its position slightly from time to time. The operation somewhat resembled that usually performed for retinal detachment. A large conjunctival flap was made downward and inward, between the internal and inferior recti. The eyeball was drawn upward and outward by means of a suture attached at the upper outer limbus, and the sclera was incised in the corresponding meridian downward and inward, as far as possible from the limbus (about 17 mm.). When the dark color of the choroid appeared in the wound, this layer was divided with the back of the Graefe knife. The entozoon immediately appeared in the wound, being expelled by the intraocular pressure without the use of any instrument. The mass was about the size of a bean. The resulting visual acuity was 6/9 with correction, and no complication had arisen three years later.

W. H. Crisp.

Byshmich, D. G. **Ocular symptoms in malaria.** Viestnik Opht., 1940, v. 17, pt. 3, p. 265.

An analysis of the ocular symptoms in 610 patients seen in the Ukraine Protozoa Institute. The conclusions are that the visual organ is very sensitive to malarial disease and that some ocular signs (such as malarial vessels, retinal edema, reduction in corneal sensitivity, hyperemia of the optic nerve, and apico-orbital pain) may be designated as characteristic or pathognomonic of malaria. Ray K. Daily.

Gleser, B. M., and Fishman, P. R. **Gonococcus diseases of the eye.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 68.

A tabulated report of 38 cases. The author believes that the results with diphtheria antitoxin are superior to those obtained with lactotherapy. Three cases of metastatic gonorrheal iritis recovered under therapy with gonococcus vaccine. Ray K. Daily.

Greear, J. N., Jr. **The eye in hypertensive cardiovascular disease: a comparative ophthalmoscopic and pathologic study.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 397.

An exhaustive clinical and pathologic study of 16 cases of severe hypertensive cardiovascular disease showing changes in the fundus. In each case detailed ophthalmoscopic observation and reports are followed by microscopic study of the viscera and posterior segments of the eye. The literature in reviewed.
David O. Harrington.

Krutova, A. H. **A case of subretinal cysticercus near the macula.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 146.

A report of a case in which the parasite was removed through a Krönlein approach to the posterior pole of the eyeball, with recovery of some vision.
Ray K. Daily.

Macnie, J. P. **Ocular lymphogranuloma venereum.** Trans. Amer. Ophth., Soc., 1940, v. 38, p. 482. (See Section 5, Conjunctiva.)

Pillat, A. **The classical symptom complex of vitamin-A deficiency—a systemic disease.** Wiener klin. Woch., 1940, v. 53, Sept. 27, pp. 779-783.

The author discusses in great detail, from clinical and histopathologic points of view, the ocular and general findings of vitamin-A deficiency. He emphasizes that only a rather prolonged deficiency will produce the characteristic manifestations, the most significant of which are those found in the eye: hemeralopia, xerosis, pre-xerosis, and keratomalacia. The first cellular elements to suffer are the retinal neuroepithelial cells. Later, through hyperkeratosis and parakeratosis, the conjunctiva loses the characteristics of mucous membrane and takes on the appearance of skin. The ocular glands (lacrimal, meibomian, sebaceous of lid margins and skin of lids) suffer, and their hypofunction adds to the desiccation of the ocular surfaces (xerosis and pre-xerosis). At this stage a characteristic pigmentation appears, spreading from the inner angles along the lower transitional folds. A positive dopa reaction shows that the pigment is formed within the epithelial cells of these regions and is not brought from elsewhere.

The author was the first to discover and study the pre-xerosis stage which may exist as a well-defined clinical picture for a long time. Its characteristic signs are: (1) loss of luster of the epithelial surface of conjunctiva and cornea; (2) the so-called drying phenomenon (desiccation of the cornea when lids are held open with the fingers); (3) diminished sensitivity of the cornea; (4) the bacteriologic finding of an

immense increase of xerosis bacilli, pneumococci, and the nonpathogenic organisms usually present in the conjunctival sac. Bertha A. Klein.

Veasey, C. A., Jr. **Vitamins of the B group and their relation to ophthalmology.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 538.

The chemistry, biochemistry, physiology, clinical manifestations, food sources, toxicity, and dosage of the water-soluble vitamins are discussed. The ocular effects of B avitaminosis are reviewed, with discussion of diagnosis, incidence, indications for therapy, and dosage. David O. Harrington.

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HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Alvaro, M. E. **Impressions of various ophthalmologic centers in the Americas.** Rev. Oto-Neuro-Oft., 1939, v. 14, Dec., p. 294.

An account of an extended visit to various ophthalmologic centers in Cuba, the United States, Mexico, and South America.

Berkovich, M. E. **Statistics and terminology of blindness in rural districts.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 122.

A statistical study shows that heading the list in the etiology of blindness is trauma, then trachoma, with glaucoma holding third place. To reduce the large number of traumatic ocular injuries among children, the author urges better supervision of children, elimination from commerce of all dangerous toys, and prohibition of the sale of any dangerous materials to children.

Ray K. Daily.

Bowman, W. **Lectures on the parts concerned in the operations of the eye, and on the structure of the retina.** Medical Classics, 1940, v. 5, Dec., p. 292.

This paper consists of two lectures delivered by Bowman before the Royal Ophthalmic Hospital in London in 1847 but of such correctness they might have been delivered yesterday. In very eloquent language, but with extreme modesty concerning himself, the great anatomist describes the structure of the cornea and sclera in quite fine detail. The lamellated structure of the stroma of the cornea was determined by allowing mercury to gravitate into it, exposing the interlamellar spaces; these were at first thought to be communicant with scleral venous channels but when the mercury under pressure did not leave the cornea, they were shown to be peculiar to that structure. This was the first description of the lamellated nature of the cornea as well as of the glass membrane which bears his name.

The second lecture deals with pathology of the cornea and several case reports. Corneal ulcer, vascularization, phlyctenular keratitis, superficial and deep punctate keratitis, and interstitial keratitis are described. A plate of seven drawings by Bowman illustrating the histology he described is included.

Morris Kaplan.

Hutchinson, Jonathan. **On the different forms of inflammation of the eye consequent on inherited syphilis.** Med. Classics, 1940, v. 5, Nov., p. 147.

This is a reprint of Hutchinson's papers for the years 1858, 1859, and 1860, presented because of their historical interest.

Hutchinson showed great personal interest in eye diseases associated with inherited syphilis in the young. Sixteen cases of iritis with an age average of 5½ months are reported in considerable detail. Sixty-four cases of keratitis

are described. Among these are acute and chronic types, simple and complicated. Obsolete names and terms are mentioned. The family history, constitutional factors, and treatment are included in the essay. Several cases of choroiditis and tarsal diseases are briefly discussed. F. M. Crage.

Lavos, George. **Legal provisions for second injuries under the workmen's compensation laws.** Outlook for the Blind, 1940, v. 34, Dec., p. 155.

A résumé of compensation laws concerning second injuries is presented. These vary almost with each state and all seem unsatisfactory since each discriminates against either employer or employee. The question revolves around cases such as an employee who, having lost an eye in a previous accident, now loses the second eye and thus becomes totally incapacitated. Should the second employer pay for total disability or for disability caused by the loss of one eye only. The author makes a plea for each state to have a "second-injury fund" from which would be paid compensation amounting to the difference between the second injury and total disability. This fund would be assessed against all employers. Fifteen states have already adopted the system. Morris Kaplan.

Mineev, T. **Treatment of trachoma in military candidates.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 142. (See Section 5, Conjunctiva.)

Mulock Houwer, A. M. **The fight against blindness in the Dutch East Indies, especially Java.** Reprint from Geneesk. Tijdschr. v. Nederl. Indien, 1940.

In 1930 there were more than 130,000 blind persons in Java and the other Dutch East Indies. Most of the blindness could have been prevented. Trachoma is the most frequent cause, and probably 5,000,000 in the islands suffer from this disease. The disease is most frequent in earliest infancy, children being infected through the mothers. In one half of the cases the trachoma heals spontaneously. In the other half serious damage results from corneal involvement, frequently with entropion. Sulphanilamide does not cure without simultaneous or previous mechanical treatment. Only 30 percent of the indigenous population attend school, so that the other 70 percent are inaccessible to treatment. One ophthalmic nurse can treat about one hundred children daily or six hundred weekly.

The number of blind from bilateral cataract in the Dutch East Indies has been estimated at 20,000. Java has only 25 oculists. The author concludes his paper with a careful plan for future action in dealing with the causes of blindness. E. E. Blaauw.

Reese, A. B. **Classification of ocular pathology.** Arch. of Ophth., 1940, v. 24, Dec., pp. 1077-1099.

This system evolved by the author and now in use in the Department of Pathology of the Institute of Ophthalmology, allows complete classification of every sort of tissue removed from the eye and its surrounding parts.

J. Hewitt Judd.

Sena, J. A. **Legal medicine and ocular accidents of industry.** La Semana Med., 1941, v. 48, Feb. 6, p. 301, and Feb. 13, p. 390.

A 33-page discussion of the subject, in the Spanish language.

Sloane, A. E. **Massachusetts vision test. An improved method of testing eyes of school children.** Arch. of

Ophth., 1940, v. 24, Nov., pp. 924-939; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1940, 100th mtg.

There is definite need for an adequate screening test which can be effectively applied by nonprofessional persons. The method must be simple and brief, and duplicate as far as possible the conditions and methods commonly used in the office of an ophthalmologist. The Massachusetts vision tests include visual acuity, heterophoria for distance and near vision, and latent hypermetropia. It provides for standardized illumination and a special test card. The results obtained by the testing of 313 school children between the ages of 7 and 15 years by one technician and one ophthalmologist, those obtained by the testing of 3,430 school children by teachers and nurses who had ordinarily given the Snellen test, and those obtained in three groups tested by other oculists are tabulated and indicate that this method is an effective screening test and appears to solve the problem as well as can be accomplished by lay people. J. Hewitt Judd.

Study of prevention of blindness from ophthalmia neonatorum. Sight-Saving Review, 1940, v. 10, Sept., pp. 211-233.

This study is in the form of a report prepared in coöperation with the National Society for the Prevention of Blindness. Numerous appendices give tables covering the United States and territories, the Canadian provinces, and Newfoundland and representing a complete inquiry into this disease and its sequelae. The attempt by the Committee on Conservation of Vision to make a detailed analysis of all cases in 1939 fell short of expectations because information requested proved to be generally unavailable to health officers. This committee recommends that during the next few years each state and provincial health authority ensure that reporting of cases is complete within the respective area. F. M. Crage.

Youshkin, Y. I. **The role of the visiting nurse in the struggle with trachoma.** Viestnik Opht., 1940, v. 17, pts. 1-2, p. 129.

After trying the method in one district, the author is convinced that sending visiting nurses to patients in their homes is more effective than having patients come to the dispensaries.

Ray K. Daily.

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ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Lloyd, R. I. **Variations in the development and regression of Bergmeister's papilla and the hyaloid artery.** Trans. Amer. Ophth. Soc., 1940, v. 38, p. 326.

The embryonic development of Bergmeister's papilla and the hyaloid artery is reviewed. Defects of development and involution are discussed and several cases of persistence of the papilla and hyaloid artery are reported. Attention is called to difficulties in differentiating these cases from glioma of the retina. David O. Harrington.

NEWS ITEMS

News items should reach the editor by the twelfth of the month

Deaths

Dr. Joseph Augustus White, Richmond, Virginia, died February 16, 1941, aged 92 years.

Dr. Charles T. Chamberlain, Portland, Oregon, died December 25, 1940, aged 60 years.

Dr. Charles David Dixon, San Antonio, Texas, died January 11, 1941, aged 69 years.

Dr. Washington A. Harper, Austin, Texas, died January 3, 1941, aged 71 years.

Dr. Leonard Niess, Trenton, Illinois, died January 19, 1941, aged 62 years.

Dr. Achilles Edward Davis, New York, New York, died January 17, 1941, aged 74 years.

Dr. Charles Francis Coulter, Great Falls, Montana, died January 2, 1941, aged 65 years.

Dr. George Benjamin Potter, Omaha, Nebraska, died January 24, 1941, aged 63 years.

Dr. George Edward Teehan, Cranston, Rhode Island, died January 4, 1941, aged 60 years.

Miscellaneous

The American Orthoptic Council, oral and practical examinations for orthoptic technicians will be held October 17, 1941, in Chicago. The written examinations will be held locally throughout the country on September 17th. Application for permission to take the examinations, properly endorsed by a sponsor, must be received before September 1st. These applications should be sent to either the American Orthoptic Council, 23 East 79th Street, New York, New York, or to Dr. E. B. Dunphy, 243 Charles Street, Boston, Massachusetts.

The American Journal of Cancer ceased publication with the December, 1940, issue of volume 40. This number contained an author-subject index of volumes 15 to 40 inclusive.

The Department of Health, City of New York, devoted a special issue of their publication "Neighborhood health" to the prevention of blindness and sight conservation. The number was well illustrated and the articles written mainly by ophthalmologists of national repute.

The National Society for the Prevention of Blindness has announced that it is coöperating with the following colleges and universities in offering, at their 1941 summer sessions, courses for the preparation of teachers and supervisors of sight-saving courses:

Wayne University, Detroit, Michigan (elementary course). June 23d to August 2d. Director of the course: Miss Margaret Soares, Supervisor of Braille and Sight-saving Classes, Detroit.

Western Reserve University, Cleveland, Ohio (advanced course). June 23d to August 2d. Director of the course: Miss Olive S. Peck, Supervisor of Braille and Sight-saving Classes, Cleveland Public Schools.

State Teachers College, Buffalo, New York (advanced course). July 7th to August 15th. Director of the course: Mrs. Winifred Hathaway, Associate Director, National Society for the Prevention of Blindness, 1790 Broadway, New York, New York.

Details regarding the courses may be obtained from the university or college, or from the director in charge of the course.

The National Society for the Prevention of Blindness published as a supplement to the *Sight Saving Review,* a pamphlet, dedicated to the memory of Dr. Park Lewis containing articles describing Dr. Park Lewis as an ophthalmologist by Dr. Eliott B. Hague, as an internationalist by Lewis H. Carris, as a founder of the lay movement for the prevention of blindness by Dr. Ellice M. Alger, and as a friend of humanity by Charles Pascal Franchot.

Societies

The annual meeting of the Western Ophthalmological Society was held at Del Monte, California, March 14, 1941. The meeting was well attended and a number of interesting papers were presented among which was one by Edward Jackson entitled "Good light for good sight." Dr. Andrew J. Browning was elected president for the coming year, Dr. Carroll L. Weeks, vice-president, and Dr. William E. Borley, secretary-treasurer. The next meeting will be held in Los Angeles, January of 1942.

Dr. Heinz Wienner of Northville, Michigan, read a paper before the Detroit Ophthalmological Society on March 27th on "Psychology of stereoscopic vision."

Dr. Frank Hartman of Detroit, Michigan, read a paper before the Society on April 24th on "Contributions to ophthalmic practice No. 1."

At the meeting of the Milwaukee Oto-Ophthalmic Society, Dr. Harry S. Gradle presented a paper "Glaucoma capsulare," and Dr. Louis Brachman spoke on "Kodachrome studies of external eye diseases."

At the annual meeting of the Texas Ophthalmological and Oto-Laryngological Society in Fort Worth, in December, Dr. Everett L. Goar, of Houston, was elected president, Drs. Burbank P. Woodson, of Temple, and Phocian W. Malone, of Big Spring, vice-presidents, and Dr. Daniel Brannin, of Dallas was reëlected

secretary. The guest speakers were: Drs. Samuel J. Kopetzky, of New York, on "Management of otitis," and Peter C. Kronfeld, of Chicago, on "Early diagnosis of glaucoma."

The fourth clinical meeting of the Wilmer Institute Residents Association was held at the Wilmer Ophthalmological Institute of the Johns Hopkins Hospital and University in Baltimore, Maryland, May 1 to May 3, 1941. A comprehensive program was presented by the staff, and one morning was devoted to the role of vitamins in ophthalmology.

At the regular dinner meeting of the Cleveland Ophthalmological Club, held March 4, 1941, the following program was presented: Dr. Lorand V. Johnson, "Vitamin-B complex in ophthalmology," with presentation of patients. Dr. George Pumphrey, case report, "The Sturges-Weber syndrome." Dr. Herbert Wright, "Visual requirements for the Air Corps of the United States Army."

The Central Pennsylvania Eye, Ear, Nose, and Throat Society was recently formed with Drs. George F. Gracey, of Harrisburg, president, and Forney P. George, of Harrisburg, secretary. The society will hold meetings the second Thursday of February, April, June, October, and December.

Personals

Miss Eivor Holst of San Francisco, California, was married to Dr. Alston Callahan of Vicksburg, Mississippi, on February 23, 1941.

The following excerpt from a letter from Professor Hans Lauber was sent in by Dr. William Thornwall Davis of Washington, D.C.:

"As you see I have moved to Krakau where I have taken charge or directorship of the eye clinic. My family is still in Warschau, and this month will find them moving here. We are happy that we all have been free of illness, and look forward to living here.

At the present time the clinic has 60 beds; however, we have space to increase this to 150 beds, so that I would have a large hospital and teaching material. The reorganization of the clinic makes an interesting and thankful problem, which I am eagerly doing.

My book about the visual fields will be finished in a short time and in a month or so will go in print. When it is finished the last and most important work of my life will be finished."

In order to devote more time to private practice, Dr. Harvey D. Lamb has resigned, effective March 1st, as pathologist to the Department of Ophthalmology of the Washington University School of Medicine, Saint Louis. Dr. T. E. Sanders has been appointed to succeed Dr. Lamb as ophthalmic pathologist.

Dr. Daniel B. Kirby announces the association of Dr. William H. Hanna in practice at 780 Park Avenue, New York, New York.

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